National Oceanography Centre

Cruise Report No. 52

RRS James Cook JC145

28 February 2018 – 4 April 2018

Rapid Cruise Report for Cruise JC145

Principal Scientists

D. Smeed

2018

National Oceanography Centre, Southampton

University of Southampton Waterfront Campus

European Way

Southampton

Hants SO14 3ZH

UK

Tel: +44 (0)23 8059 6407

Email: das@noc.ac.uk

DOCUMENT DATA SHEET

AUTHOR	*PUBLICATION*
SMEED, D et al	*DATE* 2018

TITLE

RRS *James Cook* JC145, 28 February 2018 – 4 April 2018. Rapid Cruise Report for Cruise JC145

REFERENCE

Southampton, UK: National Oceanography Centre, Southampton, 179pp.
(National Oceanography Centre Cruise Report, No. 52)

ABSTRACT

The purpose of RRS James Cook cruise JC145 was to refurbish the RAPID 26°N array of moorings that span the Atlantic from the Bahamas to the Canary Islands. Cruise JC145 departed from Santa Cruz de Tenerife on Tuesday 28th February 2017 and ended on Saturday 8th April at Freeport, Bahamas. There was a port call at Nassau, Bahamas on 27th March to exchange personnel and to take on board additional equipment.

The moorings are part of a purposeful Atlantic wide array that monitors the Atlantic Meridional Overturning Circulation and the associated heat transport. The RAPID-MOCHA-WBTS array is a joint UK- US programme.

During JC145 moorings were serviced at sites: EBH4, EBH4L, EBH3, EBH2, EBH1, EBH1L, EBHi, EB1, EB1L, MAR3, MAR3L, MAR2, MAR1, MAR1L, MAR0, WB6, WB4, WB4L, WBH2, WB2, WB2L, WB1, WBADCP and WBAL. Sites with suffix 'L' denote landers fitted with bottom pressure recorders.

The ABC Fluxes project extends the measurements on the RAPID 26°N array to include biological and chemical measurements. Cruise JC145 was the first recovery of these instruments and another set were deployed to continue measurement until autumn of 2018.

CTD stations were conducted throughout the cruise for purposes of providing pre- and post- deployment calibrations for mooring instrumentation (including oxygen and carbonate chemistry sampling) and for testing mooring releases prior to deployment.

The RAPID telemetry MkIII system was recovered from site EBHi, and 24 temperature sensors and 2 75kHz ADCPs were recovered from mooring WB1 for the MerMEED project.

Shipboard underway measurements were systematically logged, processed and calibrated, including: surface meteorology, 5m depth sea temperatures and salinities, water depth, and navigation. Water velocity profiles from 15 m to approximately 800 m depth were obtained using two vessel mounted Acoustic Doppler Current Profilers (one 75 kHz and one 150 kHz).

KEYWORDS

ISSUING ORGANISATION **National Oceanography Centre**

1 **University of Southampton Waterfront Campus**
European Way
Southampton SO14 3ZH UK
Tel: +44(0)23 80596116 Email: nol@noc.soton.ac.uk

This page intentionally left blank

List of Figure

List of tables

1 Scientific and Ship's Personnel

Name	Position	Affiliation
James Gwinnell	Master	
Phillip Gauld	Chief Officer	
Michael Hood	2nd Officer	
Samual Vargas	3rd Officer	
Christopher Uttley	Chief Engineer	
Michael Murray	2nd Engineer	
Gary Slater	3rd Engineer	
Daniel Evans	3rd Engineer	
Sebastian Ulbrich	ETO	
Paul Lucas	Purser	
Michael Minnock	CPOS	
Philip Allison	CPOD	
Neil Machin	ERPO	
Mark Moore	A/B	
Jarrod Welton	A/B	
Scott Aspland	A/B	
Nicholas Byrne	A/B	
John Haughton	Head Chef	
Jacqueline Waterhouse	2nd Chef	
Jane Bradbury	Steward	
Carl Piper	Steward	
Jack Bush	Cadet	
Sam Dawkins	Cadet	
Andrea Dodd	Cadet	
Phillip MacCullum	Cadet	
David Smeed	Chief Scientist	NOCS
Pete Brown	Scientist	NOCS
Yvonne Firing	Scientist (until 29th	NOCS
Gerard McCarthy	March)	NOCS
Darren Rayner	Scientist (from 29th	NOCS
Lin Haskins	March)	NOCS
Delphine Lovelle	Scientist	NOCS
Isabel 'Chata' Seguro	PhD Student	Univ. East Anglia
Requejo	PhD Student	
Laura Hampton	PhD Student	
Paul Provost	Correspondent	NOCS/NMFSS
Dave Childs		NOCS/NMFSS
Chris Crowe	Senior Technical Officer	NOCS/NMFSS
Colin Hutton	Technician (Moorings)	NOCS/NMFSS
Ian Murdoch	Technician (Moorings)	NOCS/NMFSS
Tom Roberts	Technician (Moorings)	NOCS/NMFSS
Juan Ward	Technician (Moorings)	NOCS/NMFSS
	Technician (Moorings)	

ITO

Table 1.1 Cruise personnel.

2 Itinerary

Cruise JC145 aboard the RRS *James Cook* sailed from Santa Cruz de Tenerife on Tuesday 28th February 2017 and ended on Saturday 8th April at Freeport, Bahamas. There was a port call at Nassau, Bahamas on 27th March to exchange personnel and to take on board additional equipment. Prior to the cruise during the passage form Southampton a test CTD was conducted on 20th February.

Work on the eastern boundary array started on 28th February with calibration CTDs followed by servicing of mooring EBH4 the following day and was completed on 10th March with the deployment of EB1. The MYRTLE-X telemetry lander was successfully recovered from site EBHi on 5th March. On 6th March the CTD wire severed during a calibration CTD. Thanks to the excellent work of the crew and technicians the CTD rosette and all instruments were recovered two days later. This did though result in a significant delay.

Work on the mid-Atlantic array, including the NOG sediment trap mooring was completed between 14th and 20th March. During the following transit to the western boundary array a number of deep Argo floats were deployed for the Scripps Institute of Oceanography, and calibration CTDs were completed prior to each float deployment. Due to bad weather it was decided to postpone the servicing of mooring WB6 at 70°W. Instead the ship proceeded directly to the port call at Nassau, which was completed on 27th March. Work on the western boundary array started with servicing of WB1 on 28th March and was completed with the deployment of WB6 on 6th April. The ship then sailed for Freeport, and docked on 8th April.

A full itinerary is given in Table 2.1 below.

Date	Operation	Start time	End time	Dur. (hrs)	Latitude (°N)	Long. (°W)	Notes
Mon 20 Feb	Test CTD						Completed during passage
Tues 28 Feb	Depart Santa Cruz	08:30					3.5 hours steam to CTD1
	CTD1	13:00	16:39	03:40	28°43.91	15°47.80	16 microcts and 6 releases
	CTD2	17:36	21:14	03:40	28°43.91	15°47.80	16 microcts and 6 releases
	Tranist to EBH4						137 Nm @ 11.4 kts
Wed 1 Mar	Recover EBH4	09:49	11:27	01:38			
	Recover EBH4L5	11:53	12:47	00:54			
	Deploly EBH4L7	13:26	13:32	00:05	27°52.15	13°30.65	
	Deploy EBH4	14;37	15:49	01:22	27°51.01	13°32.40	
	Trilaterate EBH4 / EBH4L7	16:00	17:50	01:50			
Thu 2 Mar	Recover EBH3	07:50	09:40	01:50			
	Deploy EBH3	11:02	12:40	01:38	27°48.53	13°44.78	
	Trilaterate EBH3	12:57	13:37	00:40			
	Transit to EBH2						26 Nm @ 10.5 kts
	Recover EBH2	16:00	17:05	01:05			
	Deploy EBH2	18:33	18:51	00:18	27°36.89	14°12.64	
	CTD3 to 1000m	20:53	23:55	03:02	27°37.79	14°13.19	To calibrate Ph sensors
Fri 3 Mar	Transit to EBH1						68 Nm @11.1 kts
	Recover EBH1L10	07:58	08:59	01:00			
	Recover EBH1	09:08	10:58	01:50			
	Deploy EBH1L12	11:35	11:45	00:10	27°12.25	15°25.00	
	Deploy EBH1	13:32	13:55	00:23	27°13.33	15°25.35	
	Transit to EBHi						346 Nm @ 11.6 kts Clock change to UTC -1
Sat 4 Mar	CTD 4	20:46	04:00	07:14	24°54.96	21°16.09	24 microcats

Sun 5 Mar	Recover EBHi	08:50	10:52	02:02			
	Release MYRTLE-X	11:38					Rose slowly @ 22 m/min
	Deploy EBHi	13:43	14:33	00:50	24°56.21	21°15.88	Displaced to avoid MYRTLE that was still rising
	Recover MYRTLE-X	15:56	16:20	00:24			
	Transit to EB1						171 Nm @11.2 kts
	Deploy Argo 6985	19:59			24° 42.43	21° 49.71	
Mon 6 Mar	Recover EB1L10	08:19	09:57	01:28			
	CTD 5 - 1000m	11:18	14:12	0.121	23°47.67	24°06.76	SeapHOx calibration
	CTD 6	15:04	16:07	0.044	23°47.74	24°06.77	24 microcats & 8 releases. CTD Cable severed at c. 3500m
	Start setup new CTD wire and instrumentation	18:00					
Tue 7 Mar	Recover EB1	08:57	13:00	04:03			
	Load test CTD	12:00					Termination failed on new CTD
	Start drag for lost CTD	19:40	-				
Wed 8 Mar	Wind in trawl wire	00:30	-				Slow recovery due to weight on wire
	Complete CTD recovery	-	21:15	24:35'			
Thu 9 Mar	Load test CTD	10:40					Termination failed
	Load test CTD	15:30					
	Deploy EB1L12	16:38	17:01	00:25	23°47.94	24° 8.62	New deployment site to avoid lost cable
	Stream new CTD wire	17:20	20:50	03:30			
	CTD 7	21:35	02:17	04:42	23° 46.97	26° 08.46	24 microcats

Fri 10 Mar	Deploy EB1	13:05	17:51	04:46	23°45.41	24° 9.56	
	Trilaterate EB1 + EB1L12	20:13	21:30	01:17			
	CTD 8 -200m	18:58	19:52	00:54	23° 45.70	24° 09.43	Timed to coincide with RAS sample
	Transit to NOG						931 Nm @ 11.1 kts
Tue 14 Mar	Recover NOG	09:51	12:51	03:00			
	Deploy NOG	14:08	15:36	01:28	23° 45.32	41° 05.76	
	Recover MAR3L9	16:30	18:28	01:58			
	CTD 9	19:27	00:11	04:38	23° 50.65	41° 03.68	24 microcats
Wed 15 Mar	Recover MAR3	09:57	14:18	04:21			
	Deploy MAR3L11	15:56	16:01	00:05	23° 51.74	41°05.88	
	Deploy MAR3	17:34	21:59	04:25	23° 52.28	41° 05.37	Deployed in slighty deeper water 5067m
	Trilaterate MAR3 + MAR3L10	22:32	23:55	01:23			
Thu 16 Mar	Transit to MAR1						
	Deploy Argo 6604	16:08			23° 56.32	44° 29.04	
Fri 17 Mar	Deploy Argo 6989				24° 03.10	46° 29.72	
	Recover MAR1L9	17:24	18:51	01:27			
	CTD 10	20:11	23:04	02:53	24° 11.84	49° 43.92	SeapHOx calibration
Sat 18 Mar	Recover MAR1	09:59	15:52	05:53			Top of mooring lost to long line damage. Slow to rise.
	Deploy MAR1L11	17:09	17:14	00:05			
	CTD 11	18:33	23:13	04:40	24° 10.05	49° 44.88	24 microcats
Sun 19 Mar	Deploy MAR1	12:34	17:30	04:56			
	CTD 12	17:41	18:16	00:35	24° 10.00	49° 44.46	For insitu oxygen
	Trilaterate MAR1 + MAR1L						
Mon 20 Mar	Recover MAR0	10:07	12:51	02:44			
	Deploy MAR0	14:27	14:52	00:25			

Tue 21 Mar	CTD 13	08:57	17:01	08:04	25° 00.00	55° 00.00	Calibration of ODOs requires extra time
	Deploy Deep Argo 6021	17:09			25° 00.00	55° 00.00	
Wed 22 Mar	Deploy Argo 6984	01:57			24° 55.24	56° 33.80	
	CTD 14	08:58	14:07	05:09	24° 50.99	58° 00.14	24 microcats
	Deploy deep Argo 6025	14:15			24° 51.07	58° 00.01	
Thu 23 Mar	CTD 15	06:58	12:02	05:04	24° 44.96	60° 59.94	14 microcats
	Deploy Deep Argo 6026	12:07			24° 44.84	60° 59.71	
Fri 24 Mar	CTD 16	03:27	07:39	04:15	24° 36.37	64° 00.00	For Dep Argo only
	Deploy Deep Argo 6027	04:49			24° 36.40	63° 59.99	
Sat 25 Mar	Deploy Deep Argo 6028	13:11			24° 23.20	67° 01.27	CTD cancelled due to strong winds and swell.
Sun 26 Mar	Deploy Deep Argo 6029	05:07			24° 48.54	70° 00.35	CTD cancelled due to strong winds and swell.
	Transit to Nassau						Due to forecast of bad weather at WB6 decided to postpone servicing of this mooring
Mon 27 Mar	Port call Nassau	16:00					Transfer personnel. Pickup lander and parts for RAS

Tue 28 Mar	CTD 17	09:57	13:25	03:28	26° 30.70	76° 47.56	For in-situ oxygen
	Recover WB1	13:18	16:01	02:43			
	Recover WBADCP	16:41	17:18	00:37			
	Deploy WBADCP	17:42	17:48	00:06	26°31.82	76°52.00	
	Attempt recover WBAL5						Mooring release acknowledged but did not surface.
	Locate WBAL6						Determined that was still in location deployed. (Had previously lost buoyancy).
	Deploy WBAL7	21:32	21:37	00:06	26°32.25	76°51.91	
	Attempt download data from WBAP1						Download unsuccessful. Left for recovery in 2018
	CTD 18	22:27	23:51	01:24	26° 30.69	76° 47.53	For in-situ oxygen
Wed 29 Mar	Recover WB2	12:02	15:13	03:02			
	Recover WB2L10	15:52	17:37	01:45			
	Deploy WB2L12	18:22	18:27	00:05	26°28.79	75°42.08	
	CTD 19	20:05	00:09	04:04	26° 30.52	76° 38.13	
Thu 30 Mar	Deploy WB2	13:37	17:00	03:23	26°30.80	76°44.31	
	Deploy WB1	18:48	21:06	02:18	26°29.87	76°48.93	
	CTD 20	22:26	23:37	01:11	26° 28.87	76° 48.93	900m for Contros sensor
	Triangulation						
Fri 31 Mar	Recover WBH2	12:03	15:39	03:36			
	CTD 21	19:05	23:05	04:00	26° 28.98	76° 37.58	5 micorcats
Sat 1 Apr	Deploy WBH2	13:30	16:14	02:44	26°28.94	76°37.48	
	Triangulation of WBH2						
	CTD 22	17:59	21:37	03:38	26° 30.30	76° 36.59	For in-situ oxygen
	Transit to WB4						
	CTD 23	02:27	06:35	04:08	26° 28.59	75° 45.18	For in-situ oxygen

Sun 2 Apr	Recover WB4	11:09	15:55	04:46			
	Recover WB4L10	16:17	18:10	01:53			
	Test new lander buoyancy						
	Deploy WB4L12	19:07	19:12	00:05	26° 28.78	75° 42.10	
	Triangulate WB4L12	21:06	22:02	00:56			
Mon 3 Apr	Deploy WB4	13:30	17:43	04:13	26° 27.06	75° 43.45	
	Triangulate WB4	18:12	19:08	00:54			
	CTD 24	19:21	02:32	07:11	26° 28.31	75° 44.29	Caldip with ODOs
Tue 4 Apr	Passage to WB6						
Wed 5 Apr	Start recovery of WB6	11:17	-				Rose very slowly due to imploded syntactic buoyancy
	CTD 25	23:41	03:57	04:37	26° 30.57	70° 29.81	Final caldips
Thu 6 April	Complete recovery WB6	-	12:22	25:05			
	Deploy WB6	15:13	15:44	00:31			There was no time left to do a caldip CTD for the recovered sensors
	Passage to Freeport						
Fri 7 April	Continue Passage						
Sat 8 April	Pilot on board 07:00	07:00					

Table 2.1 Cruise itinerary.

3 Introduction

This cruise report is for cruise JC145 conducted aboard RRS *James Cook* in Autumn 2015. The primary purpose of the cruise was to service the UK contribution to the RAPID-MOC/MOCHA mooring array.

The RAPID-MOC/MOCHA array was first deployed in 2004 to measure the Atlantic Meridional Overturning Circulation (AMOC) at 26°N and has been maintained by regular service cruises since then. The array and associated observations are funded by NERC, NSF and NOAA. The NERC contribution to the first four years of measurements was funded under the directed programme "RAPID Climate Change". Following an international review NERC continued funding to 2014 under the programme "RAPID-WATCH". The servicing and redeployment of the UK moorings on this cruise are conducted under the "RAPID-AMOC" programme, which is funded until 2020. NSF and NOAA have also continued funding and commitments so that the system can continue operating at the same level of activity.

RAPID-AMOC continues the measurements at 26°N and extends these to include biological and chemical measurements in order to determine the variability of the AMOC and its links to climate and the ocean carbon sink on interannual-to-decadal time scales. The ABC Fluxes project is also funded under RAPID-AMOC and is adding biogeochemical samplers and sensors to the array, with these new instruments being deployed on the array for the first time on this cruise.

The RAPID telemetry MkIII system based on the MYRTLE-X lander was deployed for the first time on the previous cruise DY039, alongside mooring EBHi, and was recovered during this cruise

Further information on the RAPID-MOC/MOCHA array please see previous cruise reports (detailed in Table 3.1)

As with previous RAPID cruises we also serviced the Northern Oligiotrophic Gyre (NOG) mooring, which is part of the FixO^3 network (more information at: http://noc.ac.uk/observatories/nog). Additional work was also conducted for the MeRMEED project: (http://gtr.rcuk.ac.uk/projects?ref=NE/N001745/1) which added 24 additional temperature sensors and two 75kHz ADCPs on the WB1 mooring.

As on previous cruises we deployed a number of Argo floats supplied by the UK Met Office. In addition 6 Deep Argo floats were deployed for Scripps Institute of Oceanography. All Argo data is freely available online see http://www.argo.net/ for further details.

3.1 Results and Data Policy

All data and data products from RAPID 26°N project are freely available. The NERC data policy may be found at http://www.bodc.ac.uk/projects/uk/rapid/data policy/. Access to data and data products can be obtained via http://www.noc.soton.ac.uk/rapidmoc/ and http://www.rsmas.miami.edu/users/mocha/index.htm). Data may also be

obtained directly from http://www.bodc.ac.uk/.

A full list of published papers is available on the programme website at http://www.rapid.ac.uk/publications.php.

3.2 Previous RAPID-MOC Cruises

Table 3.1 details the previous cruises completed as part of the RAPID-MOC project with information on the relevant cruise reports for reference, note this does not include all NOAA WBTS hydrography cruises.

Cruise	Vessel	Date	Objectives	Cruise Report
D277	RRS *Discovery*	Feb - Mar 2004	Initial Deployment of Eastern Boundary and Mid-Atlantic Ridge moorings	Southampton Oceanography Centre Cruise Report, No 53, 2005
D278	RRS *Discovery*	Mar 2004	Initial Deployment of UK and US Western Boundary Moorings	Southampton Oceanography Centre Cruise Report, No 53, 2005
D279	RRS *Discovery*	4 Apr – 10 May	Transatlantic hydrography (125 CTD stations)	Southampton Oceanography Centre, Cruise Report, No 54, 2005
P319	RV *Poseidon*	9th – 17th Dec 2004	Emergency deployment of replacement EB2 following loss	Appendix in National Oceanography Centre Southampton Cruise Report, No. 2, 2006
CD170	RRS *Charles Darwin*	Apr 2005	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	National Oceanography Centre Southampton Cruise Report, No. 2, 2006
KN182-2	RV *Knorr*	May 2005	Service and redeployment of UK and US Western Boundary Moorings and Western Boundary Time Series (WBTS) hydrography section	National Oceanography Centre Southampton Cruise Report, No. 2, 2006
CD177	RRS *Charles Darwin*	Nov 2005	Service and redeployment of key Eastern Boundary moorings	National Oceanography Centre Southampton Cruise Report, No. 5, 2006
WS05018	RV *F.G. Walton Smith*	Nov 2005	Emergency recovery of drifting WB1 mooring	No report published
RB0602	RV *Ronald H. Brown*	Mar 2006	Service and redeployment of UK Western Boundary moorings and WBTS hydrography section	National Oceanography Centre Southampton Cruise Report, No. 16, 2007
D304	RRS *Discovery*	May - Jun 2006	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	National Oceanography Centre Southampton Cruise Report, No. 16, 2007
P343	RV *Poseidon*	4th – 17th Oct 2006	Service and redeployment of key Eastern Boundary moorings	National Oceanography Centre Southampton Cruise Report No. 28, 2008.
P345	RV *Poseidon*	28th Nov – 7th Dec 2006	Emergency redeployment of EB1 and EB2 following problems on P343	National Oceanography Centre Southampton Cruise Report No. 28, 2008.
SJ-14-06	RV *Seward Johnson*	Sep – Oct 2006	Recovery and redeployment of WB2 and US Western Boundary moorings, and WBTS hydrography section	Appendix G in National Oceanography Centre, Southampton Cruise Report, No 29
RB0701	RV *Ronald H. Brown*	Mar - Apr 2007	Service and redeployment of UK Western Boundary moorings and WBTS hydrography section	National Oceanography Centre, Southampton Cruise Report, No 29
D324	RRS *Discovery*	Oct – Nov 2007	Service and redeployment of Eastern Boundary and Mid-Atlantic Ridge moorings	National Oceanography Centre, Southampton Cruise Report, No 34
SJ0803	RV *Seward Johnson*	April 2008	Service and redeployment of the Western Boundary moorings	National Oceanography Centre,

				Southampton Cruise Report, No 37
D334	RRS *Discovery*	Oct-Nov 2008	Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings	National Oceanography Centre, Southampton, Cruise Report No. 38, 2009
RB0901	RV *Ronald H. Brown*	April – May 2009	Service and redeployment of the UK and US Western Boundary moorings and the WBTS hydrography section	National Oceanography Centre, Southampton Cruise Report, No 39, 2009
D344	RRS *Discovery*	Oct – Nov 2009	Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings	National Oceanography Centre, Southampton, Cruise Report No. 51, 2010
D345	RRS *Discovery*	21 Nov – 6 Dec 2009	Recovery and redeployment of US Western Boundary moorings, and WBTS hydrography section	RAPID/MOCHA Program Report (W. Johns, RSMAS).
D346	RRS *Discovery*	5 Jan – 19 Feb 2010	Transatlantic hydrography (135 CTD stations)	National Oceanography Centre Cruise Report, No 16, 2012
OC459	RV *Oceanus*	Mar – Apr 2010	Service and redeployment of the Western Boundary moorings	National Oceanography Centre Cruise Report, No 01, 2010
RB1009	RV *Ronald H. Brown*	28 Nov – 1 Dec 2010	Recovery of WB4 and WB3L3. Redeployment of WB4.	Appendix in: National Oceanography Centre Cruise Report, No -01, 2010
D359	RRS *Discovery*	17 Dec 2010– 15 Jan 2011	Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings	National Oceanography Centre Cruise Report, No. 09, 2011
KN200-4	RV *Knorr*	13 Apr – 4 May 2011	Service and redeployment of Western Boundary Moorings and WBTS hydrography section	National Oceanography Centre Cruise Report, No 07, 2011
JC064	RRS *James Cook*	10 Sep – 9 Oct 2011	Service and redeployment of the Eastern Boundary and Mid-Atlantic Ridge moorings	National Oceanography Cruise Report, No. 14, 2012
RB1201	RV *Ronald H. Brown*	15 Feb – 5 Mar 2012	Service and redeployment of Western Boundary Moorings and WBTS hydrography section	National Oceanography Centre, Cruise Report No. 19, 2012
EN517	RV *Endeavor*	24 Sep – 10 Oct 2012	Service of US moorings in Western Boundary	RV Endeavor Cruise EN-517 Cruise Report
D382	RRS *Discovery*	8 Oct – 24 Nov 2012	Service and redeployment of full UK RAPID array	National Oceanography Centre Cruise Report No. 21, 2012
AE1404	RV *Atlantic Explorer*	15 Mar – 31 Mar 2014	Service of US moorings in Western Boundary	RV Atlantic Explorer Cruise AE-1404 Cruise Report
JC103	RRS *James Cook*	23 Apr – 3 Jun 2014	Service and redeployment of full UK RAPID array	National Oceanography Centre Cruise Report No. 30, 2015
EN570	RV *Endeavor*	3 Oct – 19 Oct 2015	Service of US moorings in Western Boundary	RV Endeavor Cruise EN-570 Cruise Report
DY039	RRS *Discovery*	17 Oct – 1 Dec 2015	Service and redeployment of full UK RAPID array	National Oceanography Centre Cruise Report, 37
DY040	RRS *Discovery*	9 Dec - 2015 – 22 Jan 2016	Transatlantic hydrography	National Oceanography Centre Cruise Report, XX
EN598	RV *Endeavor*	8-25 May, 2017	Service of US moorings in Western Boundary	
JC145	*RRS James Cook*	28 Feb – 8 Apr 2017	Service and redeployment of full UK RAPID array	This report

Table 3.1 Cruises conducted as part of the RAPID 26°N project

4 NMFSS Ship Systems Computing and Underway Instruments

Juan Ward

4.1 Ship scientific computing systems

Network drives were setup on the on-board file server; firstly a read-only drive of the ships instruments data and a second scratch drive for the scientific party. Both were combined at the end of the cruise and copied to disks for the PSO and BODC.

Data was logged by the Techsas data acquisition system into NetCDF files. The instruments logged are listed in Table 4.1

Data was additionally logged into the RVS Level-C format, which is described in the same documentation. There are also ASCII dumps of all the Level-C streams included on the data disk in the directory: *Ship_Systems\Level-C\prodata\ascii*

The Techsas system crashed on 05/03/2017 05:53 and was restarted later that morning at 08:50, resulting in the loss of all data during that time.

The MOXA converting serial data to UDP, which feeds the Techsas system crashed at the following times resulting in the loss of all (except the Seapath) data for these times:

- 30/03/2017 19:15 and was restarted by 19:48
- 01/04/2017 19:47 and was restarted by 20:17
- 03/04/2017 05:30 and was restarted by 11:00

This MOXA was replaced, resulting in loss of data during the changeover at the following time:

- 03/04/2017 20:30 and was resumed at 20:40

Manufacturer	Model	Function/data types	Logged? (Y/N)	Comments
Steatite	MM3S	GPS network time server (NTP)	N	Not logged but feeds times to other systems
Applanix	POS MV	DGPS and attitude	Y	Primary GPS
Ashtech	ADU-5	DGPS and attitude	N	
C-Nav	3050	DGPS and DGNSS	Y	
Kongsberg Seatex	DPS116	Ship's DGPS	Y	Bridge GPS
Kongsberg Seatex	Seapath 200	DGPS and attitude	Y	Secondary GPS
Sonardyne	Fusion USBL	USBL	Y	
Sperry Marine		Ship gyrocompasses x 2	Y	
Chernikeeff Instruments	Aquaprobe Mk5	Electromagnetic speed log	Y	

Kongsberg Maritime	Simrad EA600	Single beam echo sounder (hull)	Y	
Kongsberg Maritime	Simrad EA500	Single beam echo sounder (hull)	N	
Kongsberg Maritime	Simrad EM120	Multibeam echo sounder (deep)	Y	
Kongsberg Maritime	Simrad EM710	Multibeam echo sounder (shallow)	N	
Kongsberg Maritime	Simrad SBP120	Sub bottom profiler	Y	
Kongsberg Maritime	Simrad EK60	Scientific echo sounder (fisheries)	N	
NMFSS	CLAM	CLAM system winch log	Y	
NMFSS	Surfmet	Meteorology suite	Y	
NMFSS	Surfmet	Surface hydrography suite	Y	
		Skipper log (ship's velocity)	Y	
OceanWaveS GmbH	WaMoS II	Wave Radar	Y	For display only Summaries included
Teledyne RD Instruments	Ocean Observer 75 kHz	VM-ADCP	Y	
Teledyne RD Instruments	Ocean Observer 150 kHz	VM-ADCP	Y	
Microg Lacoste	Air-Sea System II	Gravity	Y	For next cruise

Table 4.1 Ship fitted instruments.

4.2 Position and attitude

All GPS and attitude measurement systems were run throughout the cruise.

The Applanix POSMV system is the vessel's primary GPS system, outputting the position of the ship's common reference point in the gravity meter room. The POSMV is the GPS sent to all systems and is repeated around the vessel.

The POSMV Gyro acquisition timed out and failed several times during the cruise, but each time was resumed within minutes.

The Seapath 300 system is the vessel's secondary GPS system, this was the position and attitude source that was sent to the EM120 due to its superior real-time heave data.

The CNav 3050 GPS system is the vessel's differential correction service, which is fed to the POSMV and Seapath systems to enable <10cm position accuracy.

4.3 EM speed logs

The single axis bridge Skipper Log and the dual axis Chernikeef science log were logged throughout the cruise. The Chernikeef log was calibrated in September 2016, in the English Channel.

It was observed by the scientists who were processing the EM log data in real-time that the Chernikeef reading drifted considerably while alongside at Tenerife, undermining confidence in the subsequent data. This is probably due both to a build-up of marine fouling on the sensor and the change of temperature and salinity of the water away from the conditions in which the sensor was calibrated.

4.4 Meteorology and sea surface monitoring package.

The Surfmet system was run throughout the cruise, excepting times entering and leaving port and whilst alongside. Please see the separate information sheet:

JC145_Surfmet_sensor_information_sheet.docx

This contains the details of the sensors used and the calibrations that need to be applied. The calibration sheets are included in the directory *Ship_Systems\Met\SURFMET\calibrations*.

The fluorimeter, transmissometer and TSG were cleaned just before the start of the cruise; and the fluorimeter and transmissometer were cleaned again whilst alongside at Nassau.

The data from the fluorimeter may be unreliable, as it was observed towards the end of the cruise that the signal was barely more than noise, and cleaning it indicated that the fluorescence had merely linearly incremented since the last cleaning due to organic build up in the sensor.

4.5 ADCPs

The ADCPs were run from Southampton, from 15/02/2017 and subsequently for the duration of the cruise. The scientific watchkeepers restarted the ADCP acquisition each morning to keep the file names and sizes manageable. The ADCP 75 machine was restarted several times owing to Windows preventing any more access to shared folders.

4.6 Kongsberg EA600 12 kHz Single-beam and EM120 multi-beam echosounders

The EA600 single-beam echo-sounder was run throughout the cruise on alternate trigger pulses to the EM120 multi-beam echo-sounder, with the exception of times during which both were disabled whilst communication was undertaken with moorings transducers.

It was used with a constant sound velocity of 1500 ms^{-1} throughout the water column to allow it to be corrected for sound velocity in post processing. Depths were logged to Techsas and Level-C.

The power settings and depth settings were varied to adapt to depth or inclement weather. During periods of moderate seas, the echosounders had difficulty registering the bottom.

The following figures show the system installation configuration. The values ordinate from the ships BLOM survey report, which is included on the data disk. The attitude angular corrections for use with the Seapath 300 system were derived from a post refit trial calibration on JC108 Sept 2014. The attitude angular corrections for use with the Applanix Posmv system are from calibration during JC103 May 2014.

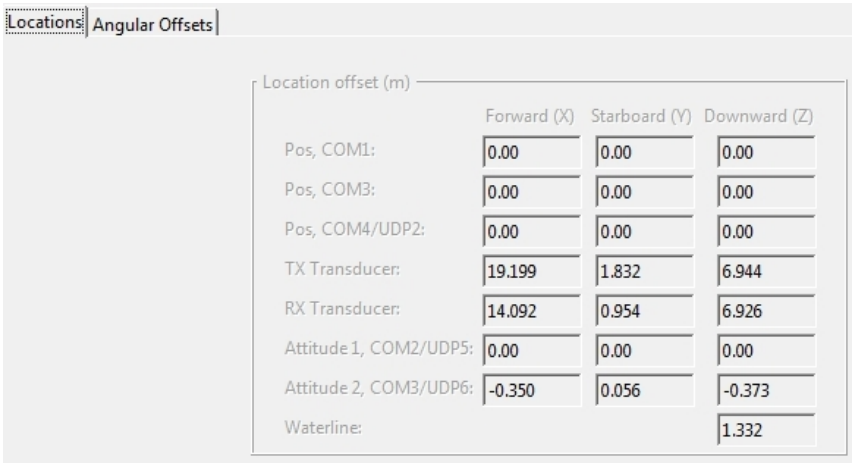


Figure 4.1 EM120 transducer locations.

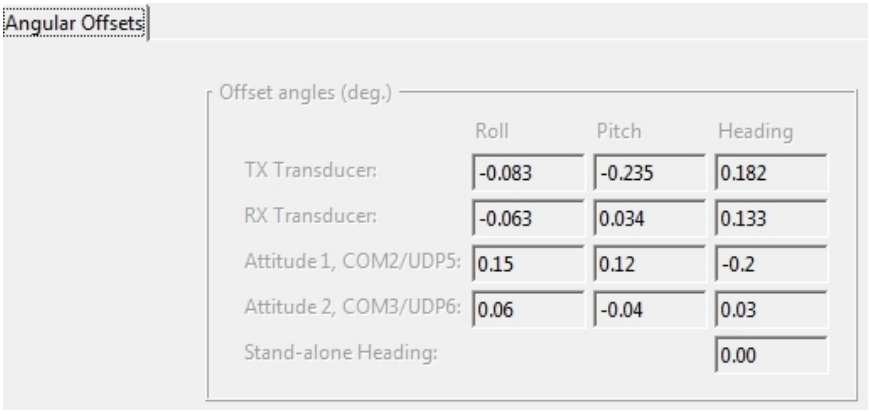


Figure 4.2 EM120 transducer offsets.

4.7 Sound Velocity Profiles.

All SVPs used this cruise were derived from CTD data and applied to the Kongsberg SIS system shortly after they were calculated. SVPs were produced on the following dates:

Date UTC	*Latitude*	*Longitude*
28/02/2017 17:31:20	28 43.91 N	015 47.81 W
04/03/2017 20:40:42	24 54.94 N	021 16.07 W

06/03/2017 15:00:20	23 47.74 N	024 06.76 W
22/03/2017 08:52:34	24 50.97 N	058 00.05 W

Table 4.2 Times and locations of sound velocity profiles

5 UNDERWAY DATA AND PROCESSING

Ros Haskins, Delphine Lobelle, Yvonne Firing

5.1 Scientific party computing

The IBM workstation "Banba" (40GB of RAM, 8x2.4 GHz Intel processors) was used on JC145 as the main location for scientific data processing. Ship data systems directly mounted included the Techsas file server, CTD data and CookFS file server. Most processing was done with Matlab v2011a using the mstar suite of programs.

The workstation was set up via a UPS. Backups were made daily to two external hard disks mounted on Banba.

5.2 Navigation, surfmet, and bathymetry data processing

The techsas files were sorted using techsas_linkscript. All available underway streams, as listed in mtnames, were processed using m_daily_proc. This script also appended the daily data onto the cruise files and cleaned some of the data streams. The daily data was then plotted to make sure that it was reasonable and to highlight any potential issues. For this, mday_plots_all creates 7 figures showing the days underway data. These include:

(1) The ships path was taken from POSMVPOS, as this gave the most reliable navigation data. SEAPOS was in good agreement however there were some errors in the data, where either/both latitude or/and longitude were recorded as 0. The cnav data was more approximate, being up to ~0.5 degrees out from the other instruments position.

(2) The head gyro was plotted using GYRO_S, which was in close agreement with GYROPMV except for a few anomalies in GYRO_S, notably at day 61.8, 62.2 and 70.

(3) The forward/aft ships speed was plotted from the Chernikeef Log (CHF) dataset. The Skipper Log (SKIP) and CHF datasets were compared to the ADCP output to establish whether they could be used for instantaneous data for water speed and direction. SKIP was found to be in good agreement with the ADCP for speed, but lacked the variables required for water direction. The CHF was split into forward/aft and port/starboard. The forward/aft appears to have become uncalibrated during the pause at Tenerife. The port/starboard has significant issues from the beginning of the data, with a strong negative trend.

(4) The surfmet data was used to plot air temperature, humidity and the wind speed and direction, as well as (5) true wind speed and direction. On days 80, 84 and 85 there were some issues with wind speed, with values alternating between

maximum and minimum values. The erroneous data has been manually removed. The true wind showed reduced impacts from changes in ships motion, but they were still sometimes apparent.

(6) Atmospheric pressure, photosynthetically active radiation (par) and total irradiance (tir) for port and starboard were taken from met_light. Towards the end of the cruise the stir data distribution became broader with flattened midday readings.

(7) The MET_TSG data gave the conductivity, salinity, transmission, fluorescence, housing temperature (temp_h) and remote temperature (temp_m), the latter being the initial intake reading. See further details below

Bathymetry data were collected throughout the duration of the cruise using a Simrad EA600 hydrographic echo sounder and an EM120 swath system. The quality of data from both systems was reduced during times of significant swell. Both systems were turned off at times when other acoustic systems were in use, such as when triggering acoustic releases on moorings. By comparing the two data sets against each other, and the expected bathymetry, they were manually cleaned and despiked using msim_plot and mem120_plot, respectively. The EM120 was generally found to be more reliable than the EA600.

5.3 TSG data and salinity calibration

On day 81 the salinity values are reduced through the evening. The fluorescence had a strong positive trend from approximately 0.1 to 1.3 Volts from Tenerife to Nassau. The instrument was cleaned while alongside, and afterwards returned to values of ~0.1 Volts.

Water samples were taken up to 4 times per day, under the condition that the vessel was traveling at more than 3 knots. This resulted in a total of 80 samples. The salinity was measured using the same Autosal as the CTD samples and the results were complied in sal_jc145_01.csv. Times and dates were edited into this before loading the data using mtsg_01. Comparison, using mtsg_bottle_compare, between sample results and TSG output allowed for the mean difference, sdiffsm, to be calculated. The sample salinity minus TSG salinity had a mean value of -0.0152 psu, with a weak linear trend. The final calibration term used for the TSG record was (-0.0001/86400)*time-0.00763, which was edited into opt_jc145 as the tsgsal_apply_cal value. To confirm that the calibration had been successful, mtsg_bottle_compare was rerun set to 'cal'.

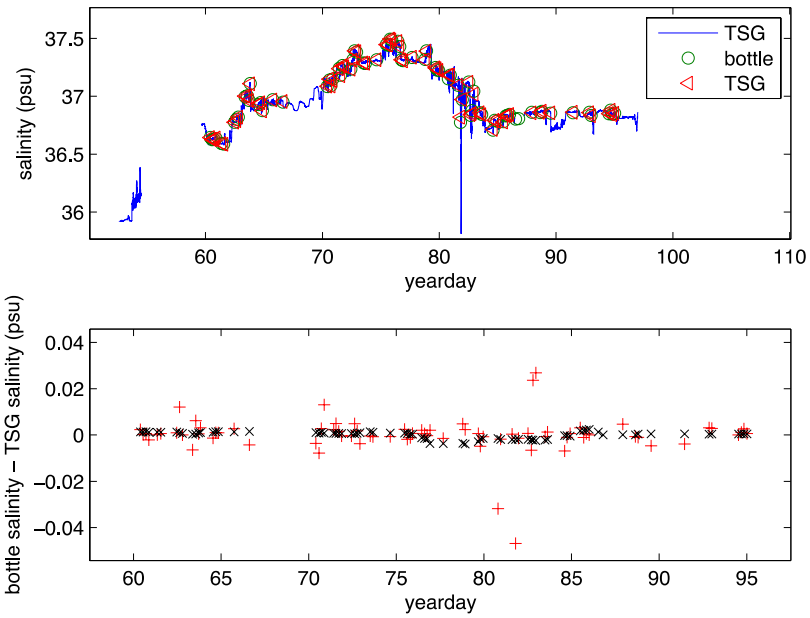


Figure 5.1 TSG salinity calibration

5.4 Vessel Mounted Acoustic Doppler Current Profiler (VMADCP)

The James Cook has two RD Instruments Vessel Mounted Acoustic Doppler Current Profilers (VMADCP). The 150-kHz was operated in broadband mode with a 4-m bin and pulse, 4-m blank before transmit, 96 bins, 6-m transducer depth, 30° beam angle, 0° nominal instrument alignment. The 75-kHz was operated in narrowband mode with a 16-m bin and pulse, 8-m blank before transmit, 48 bins, 6-mtransducer depth, 30° beam angle, 10° nominal instrument alignment. Both instruments were programmed to ping every 3 s, and were operated independently of each other and the other acoustics. Data were acquired and initial transformation into earth coordinates based on ship navigation and nominal instrument alignment was done by RDI VMDAS.

Data acquisition was stopped and restarted each morning to facilitate daily processing.

The ADCPs were configured in bottom-tracking mode for the initial steam from Southampton, 15th February 2017-25th February 2017. Subsequently they were configured in water tracking mode, although unfortunately the file names were not changed to reflect this. Sequence 902 covers the steam from Southampton to Tenerife; sequences are in numerical order (from 002 for the 75kHz or 001 for the 150) thereafter.

Processing of the VMDAS .ENX ping data relied on the University of Hawaii CODAS software (old, Matlab/Python version), with Mexec Matlab script wrappers, as described in “A User Guide to Mexec v3.0”.

An adjustment to the instrument alignment angle for the 150-kHz was made on 4th March 2017, and data were reprocessed to reflect this. Additional adjustments for both instruments were made on 5th April. The final angle and amplitude were -10.0° and 1.0 for the 75 kHz, and -1.3° and 1.0 for the 150 kHz. To check the calibration, the plots were made of the currents measured during

the trilateration of moorings EB1 and WB1. These section include sudden changes in the ship's speed and direction, however, these are not evident in the data adding confidence to the calibration .

The computer running VMDAS for the 75-kHz had recurring problems serving its network mounts, which we attempted to get around by restarting the computer (at the morning acquisition restart) every couple of days.

The 75-kHz data appear to be affected by a scattering layer around 300-500 m depth, visible as a local amplitude maximum and a ~30-m-deep band of forward ocean velocity bias (the aft-biased layer is not evident).

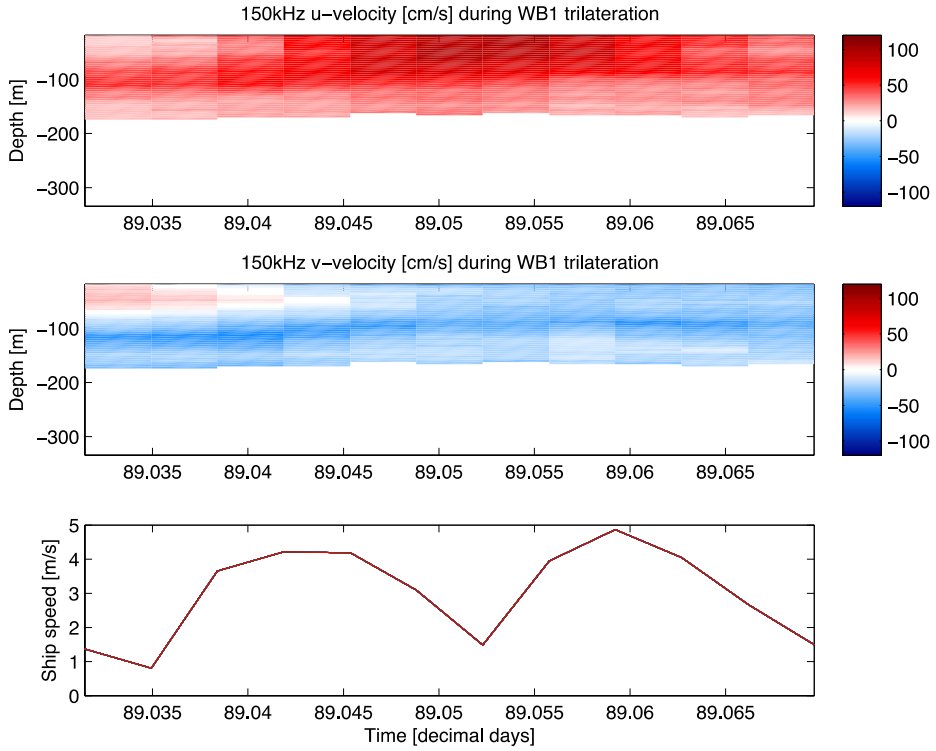


Figure 5.2 Ship's speed and VMADCP data acquired during the trilateration of WB1.

Sequence number	Julian days	Reason for removing bad pings/bins
902	47-48 49.36 52.76-52.77	Top bin removed due to ringing (seen in fore abs velocity). Also 47.4-47.5 questionable top 20-m values that weren't removed. Sudden decrease in ship speed (all bins) Top bins due to bubbles
18	72.70 72.80	Jitter Ship speed increased
19	73.65 73.70 73.95	Jitter and ship speed Jitter and ship speed Jitter and ship speed
20	75.45	Unknown

23	77.88 77.60-77.88	Sudden increase in ship speed Whole section had the same values
27	82.10	Sudden decrease in ship speed
31	85.85	Sudden decrease in ship speed
33	87.05	Sudden increase in ship speed
34	88.13	Unknown
35	89.10	Sudden decrease in ship speed

Table 5.1 Edits made to the 75kHz VMADCP data

6 CTD operations

John Wynar

6.1 CTD System Configuration

See separate Sensor Information document.

6.2 CTD Operations

The pressure sensor was located 33cm below the bottom and approximately 72cm below the centre of the 10L water sampling bottles. The bottles were fitted at alternate positions (starting at position 2) around the rosette to allow for better weight distribution when other instrumentation was attached to the frame for calibration purposes (relative to the SBE 9plus).

The configuration file, used is included in the appendix at the end of this report. This was initially JC145_1257_NMEA.xmlcon. However, after the loss of the CTD package during cast 006, from cast 007 onwards JC145_1182_NMEA.xmlcon was used.

CTD2 was terminated at the start of the cruise; an insulation figure of > 1000MΩ o/c was initially obtained and a s/c value of 75Ω. Cable CTD2 was used up to and including cast 6 when the wire parted with approximately 3356m wire out. Subsequently CTD1 was used. This was terminated giving values for the wire of 241MΩ o/c and a s/c value of 75Ω. Before use, the wire was streamed vertically to a depth of approximately 5500m using an anchor weight and a swivel. The MDS electromechanical swivel s/n: 1246-1 was used throughout.

Sensor Failures

There were no sensor failures as such. However, from cast 007 onwards a completely different sensor suite and frame were used due to the (temporary) loss of the first package.

6.3 Data processing

Basic post-processing of the CTD cast data was done to guidelines established with BODC (ref. Moncoiffe 7th July 2010) with the following exceptions which were requested by the Principal Scientist:

a) No filtering was carried out;

b) Under Data Conversion, Miscellaneous tab, the "Apply hysteresis correction to SBE43…" etc was unchecked;
c) For similar reasons, under Align CTD, Data Setup tab, no advance was applied to the Oxygen, SBE43.

6.4 Salinity measurement

A Guildline Autosal 8400B salinometer, s/n: 65764, was used for salinity measurements. The salinometer was sited in the Constant Temperature laboratory. The bath temperature was set at 21°C, the ambient temperature varying between 18.9°C and 21.5°C. A bespoke program written in Labview called "Autosal" was used as the data recording program for salinity values.

Salinity samples were taken and analysed from casts and the results being tabulated in a spreadsheet SALFORM.xlsx.

7 CTD Data

David Smeed

A total of 25 CTDs were completed during the cruise. On CTD 6 the wire severed and so a completely different frame, bottles and instruments were used for the remainder of the cruise.

Most casts were for the purposes of calibration of the microcat CTDs, but some were completed before and after recovery of moorings with oxygen sensors to enable in water calibration of oxygen, and others were completed before the deployment of Deep Argo floats. The shallow casts were to obtain samples for calibration of the SeapHox and HydroC sensors.

There were 12 bottles on the frame and on most deep casts they were all used to obtain samples to calibrate the oxygen and salinity. Bottle stops were all 5 minutes each except on casts where there were ODOs, then the stop time was increased to 20 minutes.

Stat-ion	Start Date	Start Time	End time	Latitude	Longitude	Water depth (corr. m)	Profile depth (m)
1	28-Feb	13:00	16:39	28°43.91	15°47.80	3603	3576
2	28-Feb	17:36	21:14	28°43.91	15°47.80	3603	3576
3	02-Mar	20:53	23:55	27°37.79	14°13.19	2017	999
4	04-Mar	20:46	04:00	24°54.96	21°16.09	4487	4463
5	06-Mar	11:18	14:12	23°47.67	24°06.76	5094	998
6*	06-Mar	15:04	16:07	23°47.74	24°06.77	5094	3355
7	09-Mar	21:35	02:17	23° 46.97	24° 08.46	5016	4998
8	10-Mar	18:58	19:52	23° 45.70	24° 09.43	5086	204
9	14-Mar	19:27	00:11	23° 50.65	41° 03.68	5449	5430
10	17-Jul	20:11	23:04	24° 11.84	49° 43.92	5229	999
11	18-Mar	18:33	23:13	24° 10.05	49° 44.88	5216	5190
12	19-Mar	17:41	18:16	24° 10.00	49° 44.46	5206	200
13	21-Mar	08:57	17:01	25° 00.00	55° 00.00	5960	5944
14	22-Mar	08:58	14:07	24° 50.99	58° 00.14	6019	6001

15	23-Mar	06:58	12:02	24° 44.96	60° 59.94	5889	5868
16	24-Mar	03:27	07:39	24° 36.37	64° 00.00	5372	5352
17	28-Mar	09:57	13:25	26° 30.70	76° 47.56	2463	1400
18	28-Mar	22:27	23:51	26° 30.69	76° 47.53	2497	1400
19	29-Mar	20:05	00:09	26° 30.52	76° 38.13	4616	4596
20	30-Mar	22:26	23:37	26° 28.87	76° 48.93	2226	900
21	31-Mar	19:05	23:05	26° 28.98	76° 37.58	4731	4711
22	01-Apr	17:59	21:37	26° 30.30	76° 36.59	4750	4734
23	02-Apr	02:27	06:35	26° 28.59	75° 45.18	4711	4700
24	03-Apr	19:21	02:32	26° 28.31	75° 44.29	4708	4696
25	05-Apr	23:41	03:57	26° 30.57	70° 29.81	5506	5493

Table 7.1 CTD stations.

7.1 Analysis of standard seawater samples and calibration of the salinometer

All standard seawater samples were from batch P160 with K15 = 0.99983 (Practical salinity 34.993). A standard was used before and after each crate of salinity samples. A total of 25 standards were used. When the first standard was run it was found that an offset of 0.000024 was needed. Unfortunately, the sample values were not recorded. However, from the offset and K15 value it can be deduced that the sample average was 1.999636 (=2*0.99983-0.000024). This deduced value was added as the first line of the sal_jc145_01.csv file. In this file standard samples are indicated by sample numbers from 99901 to 99925.

The inferred offsets of the salinometer readings required to match the standard sample conductivity are shown as blue crosses in Figure 7.1 . Results are shown a) as a function of the standard number and b) as a function of the date on which the samples were analysed. The red lines indicate the offsets applied. From these the offsets applied salinometer conductivity readings for the bottle samples were determined 'by eye' and are shown by the red lines. The values of the applied offsets are given in Table 7.2.. It is coincidental that the CTD cast numbers correspond with the seawater standards. Note that a change of 5 x10-5 corresponds roughly with a salinity change of 0.001. These values were entered into the Cruise Options File opt_jc145 and were applied in the calculation of bottle salinities using the routine msal_01.

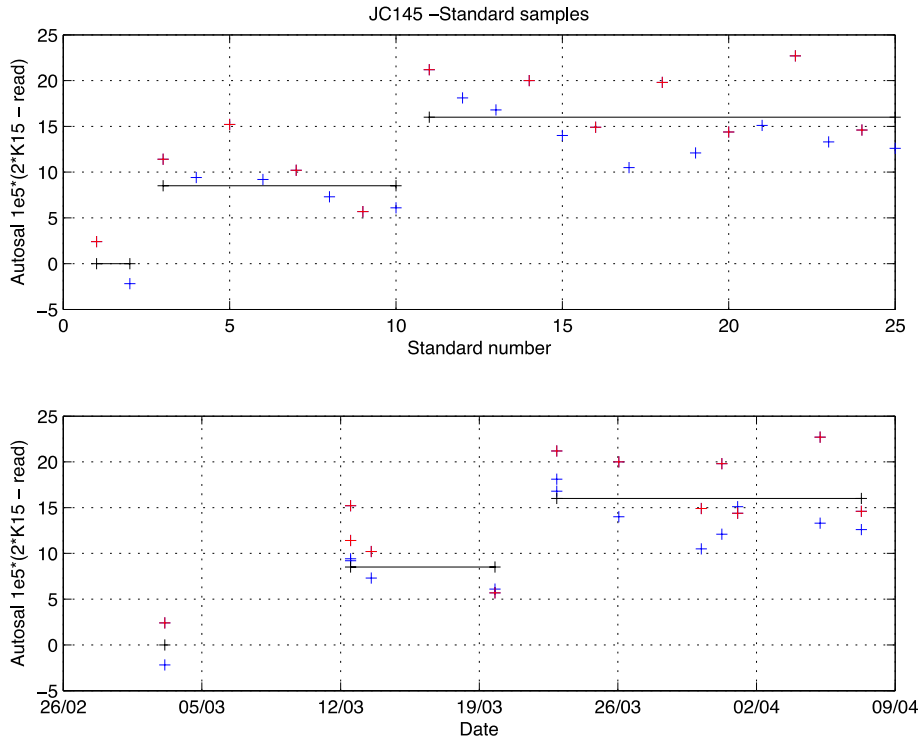


Figure 7.1 Standard seawater samples pre (red) and post (blue) samples. Inferred offsets are calculated as 2xK15 – salinometer average. The black lines denote applied offsets.

Standards	CTD casts	Underway samples	Offset
1, 2	1, 2	None	0.000000
3 - 10	3 - 10	600932-711320	0.000085
11 - 25	11 - 25	711709-950008	0.000160

Table 7.2 Offsets applied to the salinometer readings of CTD bottle and underway salinity samples

7.2 Calibration of conductivity and choice of primary sensors

For each conductivity sensor a calibration of the following form was applied

$$Cond\_cor = Cond\_raw*(1 + A + B*Press/1000 + C*Temp)/1000$$

The coefficients A, Band C were determined in parallel using least squares multiple linear regression (Matlab function 'regress') that minimised the sum of the squares of the residuals

$$Res = (Cond\_sam / Cond\_raw) - 1 - (A + B*Press/1000 + C*Temp)/1000$$

The coefficients of the calibrations are shown in Table 7.3.

CTD setup	Sensor set	A	B ($dbar^{-1}$)	C ($°C^{-1}$)	Mean diff ($x10^3$) Pre-cal	RMS diff ($x10^3$) Post cal.	No. of Sam.	No. of Out-liers
	Sens 1	0.03006	-0.00934	-0.00512	1.32	0.83	46	1
	Sens 2	0.06040	-0.01482	-0.00634	0.88	0.84	46	1
	Sens 1	-0.02086	-0.00732	-0.00554	3.51	0.98	157	8
	Sens 2	0.02576	-0.01267	-0.00308	1.06	0.97	157	8

Table 7.3 Details of the conductivity calibrations. The mean salinity difference (x 10^3) between bottle sample and sensor is shown pre-calibration

For the sensors used on casts 1 to 6 the temperatures recorded by the two sensors differed by less than 0.001 °C with sensor 1 being slightly warmer. Sensor set 2 (mounted on the fin of the CTD frame) was chosen as the primary sensor set as these are slightly less affected by the wake form the CTD package and so have a slightly lower level of noise during the descent of the CTD and have a little more variability during the bottle stops.

For the sensors used during casts 7 to 25 the temperature of sensor 1 was about 0.0015°C warmer than sensor 2. Sensor set 2 was chosen as the primary sensor set for the same reasons as above. In addition, the temperature sensor 2 had a more recent calibration (March 2016) than sensor 1 (September 2015), and the initial calibration of conductivity sensor 2 was somewhat better than that of sensor 1 (see Table 7.3).

8 Argo float deployment

There were 10 Argo floats deployed during the cruise: 4 regular 2000db floats and 6 Deep Argo floats deployed on behalf of Scripps Institute of Oceanography. CTD profiles were completed before the deployment of deep floats 6021,6025, 6026 and 6027, but due to poor weather no CTD profiles were performed before deployment of floats 6028 and 6029

Float number	Date	Time	Latitude (°N)	Longitude (°W)
6985	05-Mar-17	19:59	24° 42.43	21° 49.71
6604	16-Mar-17	16:08	23° 56.32	44° 29.04
6989	17-Mar-17	01:53	24° 03.10	46° 29.72
6021	21-Mar-17	17:09	25° 00.00	55° 00.00
6984	22-Mar-17	01:57	24° 55.24	56° 33.80

6025	22-Mar-17	14:15	24° 51.07	58° 00.01
6026	23-Mar-17	12:07	24° 44.84	60° 59.71
6027	24-Mar-17	04:49	24° 36.40	63° 59.99
6028	25-Mar-17	13:11	24° 23.20	67° 01.27
6029	26-Mar-17	05:07	24° 48.54	70° 00.35

Table 8.1 Argo float deployments.

9 Oxygen analysis

Isabel Seguro (Chata).

The CTD oxygens were calibrated by automatic Winkler titration of discrete water samples with amperometric electrode to endpoint detection. Two different CTD with 2 oxygen sensors (primary and secondary) each where used during the cruise. CTD 2 was used from cast 1 to 5. Cast 6 was lost as the CTD cable snapped during the deployment. Two different sensors where used in CTD 1 from cast 7 to the end of the cruise. Each CTD sensor is calibrated separately.

9.1 CTD sampling

A total of 23 CTD casts were sampled for dissolved oxygen. All fired depths were sampled (usually 12 depths) unless there were leaking Niskin bottles that were considered misfired. Triplicates were taken for the first 10 casts to assess method reproducibility, which the standard deviation was from 0.002 to 0.50 µmol L^{-1} (n = 40) after removing 3 wrong replicates. Because the reproducibility was considered good, duplicates were only randomly taken after that.

The protocol was similar to the one followed in previous RAPID cruises (see RAPID cruise report number 30 and 37) and following: (Culberson, 1991; Grasshoff, 2007).

To minimise the extension of the report we summarise here only the main steps on the attached sketches. See previous reports for more details.

Tips:

1. Putting the lid to the samples immediately after collecting them and minimising the timing while handling the sample.
2. Holding the bottles from the neck minimise changes in water temperature.
3. Measure the temperature just before fixing the sample.
4. Twisting the bottles about 20 times of 15 seconds after addition of the two chemicals is enough to get a homogeneous sample.
5. No second shake was done as other protocols suggests.
6. The bottles were not submerged but a centimetre water seal was added around the lid.
7. Strong change in the room temperature created bubbles in all the samples of one CTD cast (number 13). For that reason submerging the samples in cool water is recommended if possible.
8. For every sample, place the pipette tip of the Thiosulphate at the same level.

9. Pipette tips should not be pointing to the electrode directly.
10. Keeping the samples for several days and analyse them every 3-4 days is more time efficient and accurate as you avoid possible bias of the Thiosulphate standardisation.

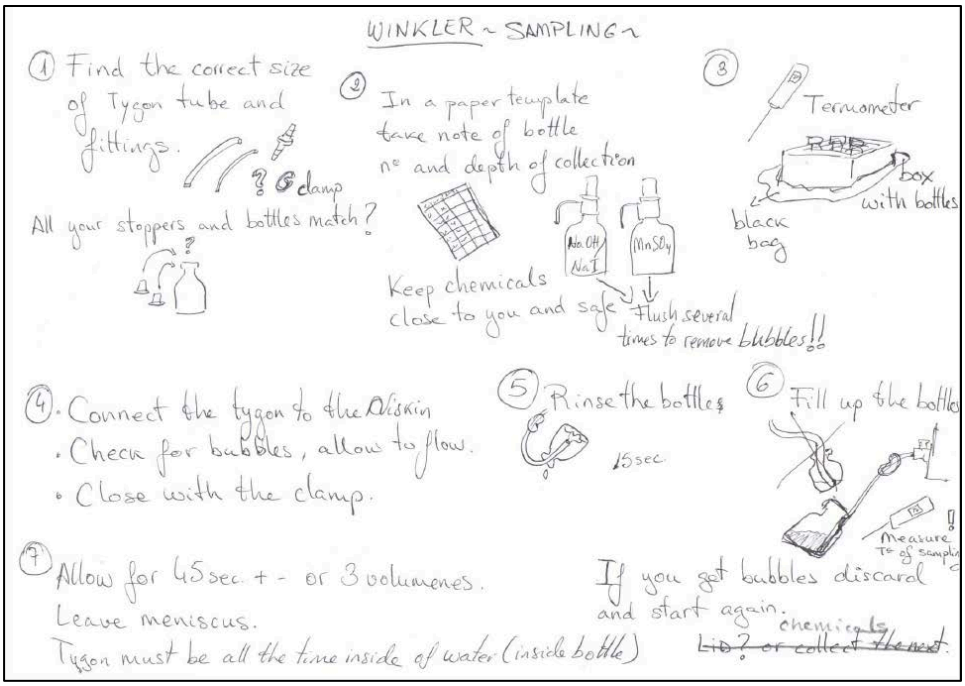


Figure 9.1 Winkler sampler.

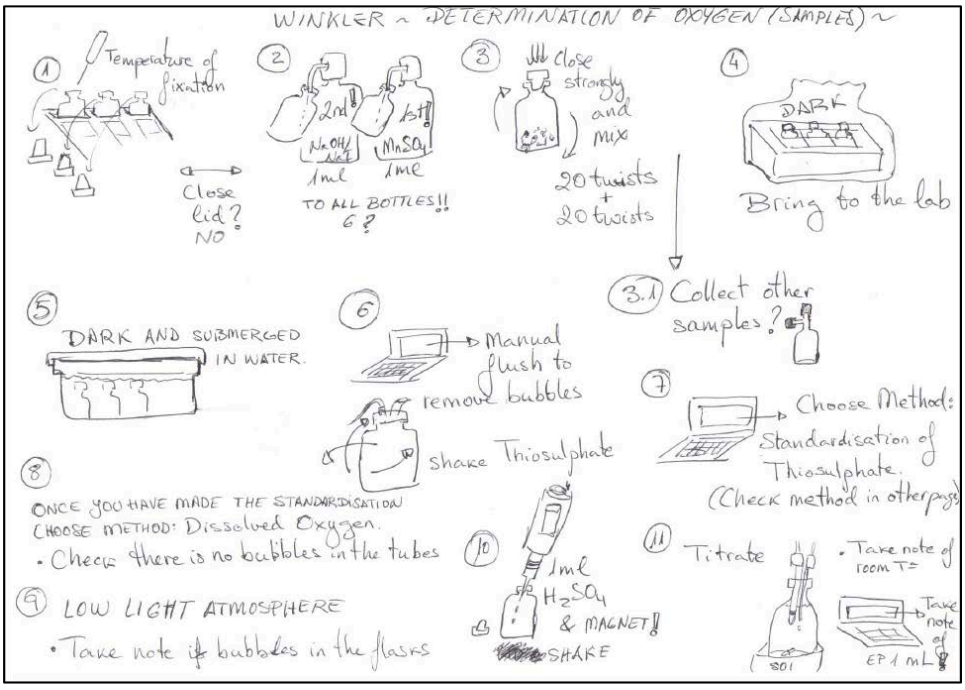


Figure 9.2 Winkler sample analysis.

9.2 Winkler titration

The Winkler method is an iodometric titration in which oxygen in the seawater sample quantitatively oxygenates iodide ions to from iodine. This is a multi-step

oxidation, using manganese as a transfer medium. The dissolved oxygen concentration of seawater is defined as the number of micromoles of oxygen gas per kilogram of seawater, which gives the units ($\mu mol\ kg^{-1}$).

The figure below illustrates the standardisation of sodium thiosulphate

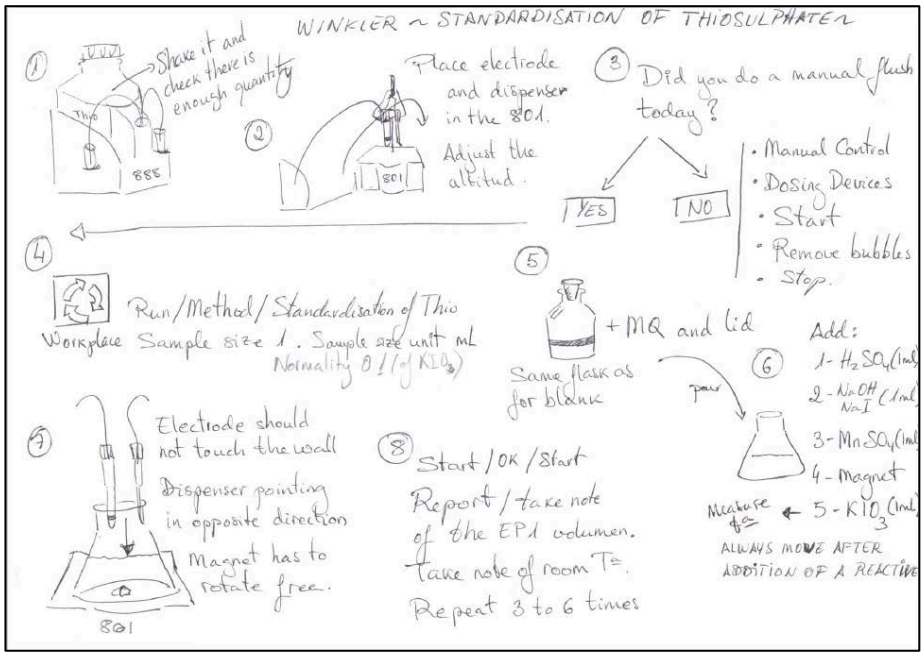


Figure 9.3 Standardisation of thiosulphate

The blank is the results from redox species apart from oxygen in the reagents, given by the expression $V_{blank} = V_2 - V_1$. Here V_2 and V_1 are the volumes of $Na_2S_2O_3$ used to titrate the first and second aliquots of the KIO_3 standard.

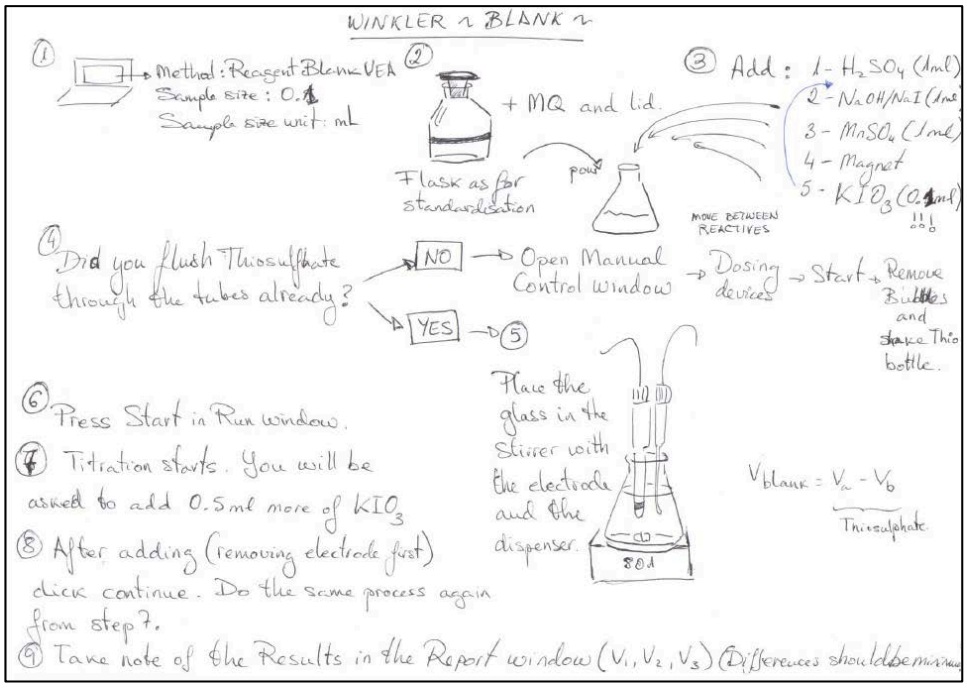


Figure 9.4 Determining blank for Winkler analysis

9.3 Comparison with CTD sensors

Comparisons between Winkler samples from Niskin bottles and the oxygen reading from the CTD sensor agreed well.

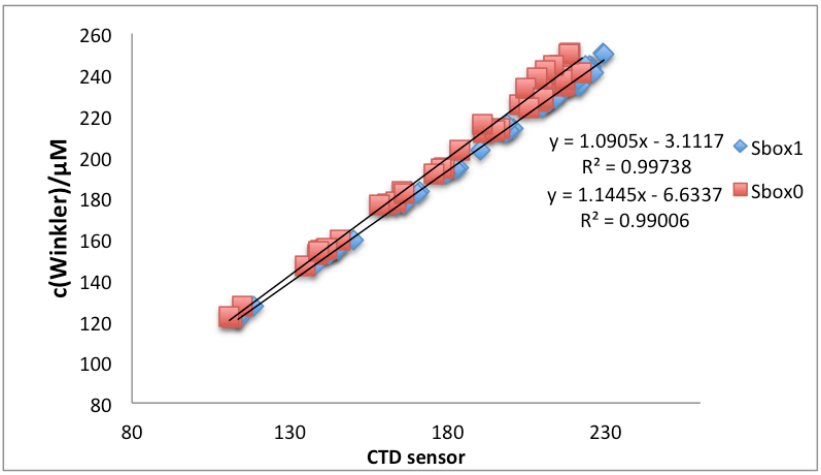


Figure 9.5 CTD 2, casts (1 – 5). Primary and secondary sensor Sbox0, Sbox1 respectively. Note that no corrections for density or pressure have been applied to the Winkler results.

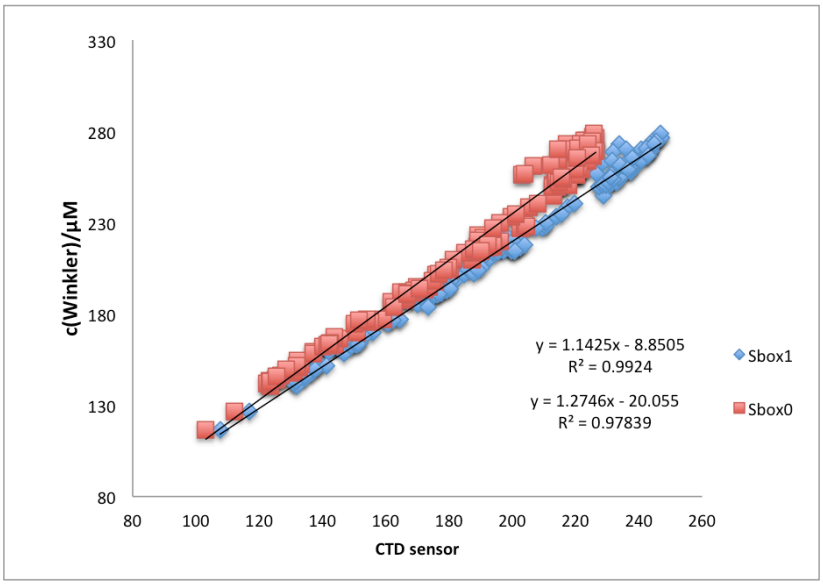


Figure 9.6 CTD 1, casts (7 – 25). Primary and secondary sensor Sbox0, Sbox1 respectively. Note that no corrections for density or pressure have been applied to the Winkler results.

10 Discrete chemical sampling

Pete Brown, Chata Seguro

Discrete bottle samples were collected for the later analysis of dissolved inorganic carbon, total alkalinity, inorganic nutrients and organic nitrogen on a number of CTD stations. These were either for providing an independent, in situ pH sensor calibration

profile, or Niskin closures were timed to coincide with the collection of the first water sample by a recently deployed Remote Autonomous Sampler (RAS).

10.1 Inorganic carbon

A total of 8 stations were sampled. Details of these are given in Table 1, including details of the number / depth of samples collected. The method followed was as described in Dy039 cruise report. Samples were stored in a fridge at approximately 6°C until the end of the cruise. At the time of each surface layer RAS, additional replicates were also taken from the ship's non-toxic seawater supply. Extra surface samples were taken towards the end of the cruise to investigate spatial variability at the western boundary of carbon parameters.

10.2 Inorganic nutrients / organic nitrogen

Samples were collected as per cruise report for DY039.

Date	Station	Location	Sample Depths	Comments
03-03-17	CTD 3: pH sensor pre-deployment calibration	27.37°N 14.13°W	1000, 750, 500, 250, 100, 50 m, underway	No nutrient samples taken
06-03-17	CTD 5: pH sensor pre-deployment calibration	23.47°N 24.6°W	1000, 750, 500, 250, 100, 50 m, underway	No nutrient samples taken
10-03-17	CTD 8: EB1 post-deployment RAS calibration	23.45°N 24.09°W	124, 100, 80, 61, 41, 20m, underway	Nutrient samples in duplicate at all depths
17-03-17	CTD 10: MAR1 pre-recovery RAS calibration & pH sensor pre-deployment calibration	24.11°N 49.43°W	1000, 750, 500, 250, 100, 50 m, underway	No nutrient samples taken
19-03-17	CTD 12: MAR1 post-deployment RAS calibration	24.10°N 49.44°W	119, 100, 80, 59, 40, 20 m, underway	Nutrient samples in duplicate at all depths
28-03-17	CTD 17: WB1 pre-recovery RAS calibration & pH sensor pre-deployment calibration	26.30°N 76.47°W	1397, 999, 750, 302, 83, 43 m, underway	Nutrient samples in duplicate at all depths
30-03-17	CTD 20: WB1 post-deployment RAS calibration	26.28°N 76.48°W	896, 822, 722, 622, 399, 199, 80,	Nutrient samples at all depths

			60, 40 m, underway	
01-04-17	CTD 22: WBH2 post-deployment RAS calibration	26.30°N 76.36°W	4738, 3498, 2397, 1700, 1602, 1502, 1403, 1303, 954, 765, 604, 57 m, underway	Nutrient samples at all depths

Table 10.1 Summary of CTD casts sampled for carbon and nutrients.

11 Contros HydroC CO_2 sensors

Pete Brown & Darren Rayner

11.1 Background

The Contros Systems & Solutions GmbH (www.contros.eu) HydroC is a membrane-diffusion-based submersible pCO_2 sensor that can be deployed in all conditions and up to 6000 m in depth. It uses a gas-permeable membrane to equilibrate seawater pCO_2 with an internal headspace that is continually circulated, dried by soda lime, and analysed by non-dispersive infrared absorption (NDIR) spectroscopy. The sensor is capable of measurements at intervals of 1s to 1week for a period up to and including 18 months dependent on deployment conditions, and can be used in an online or autonomous mode.

The sensors used on DY039 and on this trip were configured with flow-through head and pumps (in this instance low-power Seabird Electronics 5M pumps) that directly move seawater across the anti-fouling copper-protected membrane, speeding up the equilibration and response time.

11.2 Recovery of sensors deployed on DY039

EB1 (S/N CO2-1114-001):

The sensor was heavily fouled on retrieval. No communication was possible with the sensor when connected to the mains, although it could be heard to be running / vibrating. Correspondence with Contros recommended the removal of the internal memory card to access data. When pursued and the SD card taken out, it was not possible to read any data on either Windows or Mac OSX systems with both identifying the memory card as corrupted

MAR1 (S/N CO2-1114-002):

This sensor was attached to the RAS frame that was on the upper part of the mooring lost in October 2016.

WB1 (S/N CO2-1114-003):

The sensor was heavily fouled on retrieval. Communication was possible with the sensor when connected to the mains, and partial data download achieved. However, this was only for a 3 week interval starting with deployment. Removal of the SD card enabled the manual download of the full data file. This was partially corrupted, and

held data only for 3 week windows of November-December 2015, May 2016, August 2016, September 2016 and October 2016. The sensor was cleaned, run in deionised water and air before being prepared for shipment to Germany for post-cruise calibration.

11.3 JC145 deployments

Calibration

Each sensor was specially calibrated in Kiel, Germany in Dec 2016, and was unused until this trip. Calibration conditions had been chosen to optimize performance in subtropical waters at ~50 m depth, but allowing for substantial knockdown (200 m+). Specifically, calibration was performed in waters of 15-30°C for a measuring range of 200-1000 µatm.

Mooring Location	Deployment date	Serial Number	Sampling time: local (UTC)	Settings
EB1	10-03-2017	CO2-0812-020	23:03-00:00 (00:03-01:00)	Zero (Average 5s, Log 10s) Flush (Av. 5, Log 5) Measure (Av. 10, Log 10)
MAR1	19-03-2017	CO2-0812-005	23:03-00:00 (02:03-03:00)	Zero (Average 5s, Log 10s) Flush (Av. 5, Log 5) Measure (Av. 10, Log 10)
WB1	30-03-2017	CO2-1114-002	23:03-00:00 (03:03-04:00)	Zero (Average 5s, Log 10s) Flush (Av. 5, Log 5) Measure (Av. 10, Log 10)

Table 11.1 Sensor specific information

Setup

As per DY039, the sensors were set up using the Contros Detect software package (currently PC only), with daily measurements at midnight local time. Each daily measurement was set to comprise the following steps: sensor wake-up, warm-up, zero, flush, measure and sleep according to the timings in Table 11.2.

Step	Action	Duration (minutes)	Cumulative time (minutes)	Time of day (local)
1	Sensor wake up	2	(0)	
2	Warm-up	35	35	23:03 – 23:38
3	Zero	2	37	23:38 – 23:40
4	Flush	18	55	23:40 – 23:58
5	Measure	2	57	23:58 – 00:00
6	Sleep	1383	1440 (24 hours)	00:00 – 23:03

Table 11.2 Process steps during single sample measurement for HydroC.

For all deployments, the sensor was programmed to make its first measurement the night before final deployment in the laboratory. Wake-up / warm-up was set to begin at 23:03 local time, so the final measurement phase would occur from 23:58 – 00:00. The sensor was connected to its battery pack at 22:55 and was found to have entered sleep mode at 00:00 following a measurement.

12 Satlantic SeapHOx sensors

Pete Brown & Darren Rayner

12.1 Background

The Satlantic (www.satlantic.com) Deep SeapHOx pH, temperature, salinity, pressure and oxygen sensor is the combination of a SeaFET pH sensor with a Seabird MicroCAT CTD and SBE63 oxygen optode. Although the MicroCAT-ODO is a well-developed piece of instrumentation, the Deep SeaFET pH sensor is very novel with sensor serial numbers 2, 3 & 4 being used on DY039, a new pressure housing increasing its depth capacity from 50m to 2000m.

Prior to the cruise in October 2016, Satlantic notified us of the possibility of the instruments being flooded during deployment. This was because they had identified the counter electrode had been manufactured from stainless steel rather than titanium. This is prone to crevice corrosion, and we were informed that this may occur on the sensors deployed. All sensors to be deployed on JC145 use titanium counter electrodes.

12.2 Recovery of sensors deployed as part of DY039

EB1: SeaFET SN 4, ODO SN 12906 – Deployed 03/11/2015 Recovered 07/03/2017

The system was recovered in a heavily fouled condition, and initially no contact could be made with the unit. When plugged into the mains, communication was possible indicting that the batteries had died. Data was downloaded but took a long time (7 hours +) due both to the speed of the serial connection, and it being a single data file. This unit had initially been set up to sample every 30 minutes in the belief that the battery could sustain this response over the full deployment. However, batteries died in June 2016. Data was missing from November 2015 making deployment calibration difficult. Substantial systematic differences from bottle samples taken during DY040 were observed, but these can be used to post calibrate the data. Instrumental drift was also apparent. An exponential drift was also identified with respect to the oxygen output that will require post-cruise calibration.

MAR1: SeaFET SN2, ODO SN 12905 – Deployed 12/11/2015

This sensor was attached to the RAS frame that was on the upper part of the mooring lost in October 2016

WB1: SeaFET SN 4, ODO SN 12903 – Deployed 30/11/2015 Recovered 28/03/2017

The system was recovered in a heavily fouled condition. The pressure compensation valve situated in the centre of the unit's end cap was missing, and the unit was flooded. The pressure housing was heavily corroded, specifically at the location of the end cap, but also across the main body and at the electrode end, where the copper nickel outlet port was also corroded. Upon removal of the end cap, one set of 4 batteries was found to be corroded, but the other two sets were found to be in good condition. The main electronics stack was removed

from the housing and corrosion found on the main board. No memory card was found to look for data, so the unit will be returned to Satlantic for analysis. It is not known whether the cause of the instrument flooding was due to the stainless-steel counter electrode.

12.3 Sensor setup for deployment on JC145

All sensors were placed in a seawater reservoir set up in the chemical lab within the first two days of the cruise and powered on. This was to allow the electrode to acclimatise and condition to seawater conditions. The procedure used for setting up the sensors during DY039 was followed here. Pre-deployment CTD tests were performed for all sensors, by setting them to continuous mode and attaching them to the CTD frame before being lowered to 1000-1400 m. This was used to check that the SeaFET and Microcat-ODO were in communication, and that instrument response was as expected. Discrete bottle samples were also collected during these casts to be used as an initial calibration. At least 24 hours before deployment, new batteries were installed, the instrument powered on and a lab test conducted to ensure that pH values were being produced.

It was found that for one sensor, the SeaFET was not collecting information from the CTD. It was found that the Microcat-ODO settings were not correct to allow communication. This was remedied by using the Command Terminal (Menu 'Sensor' -> 'Advanced' -> 'Command Terminal') to directly communicate with the Microcat-ODO using 'ctd term'. As per the Deep SeapHOx quick start guide, the following MicroCAT settings were input to ensure proper Deep SeapHOx operation:

• Set baud rate for communication with Deep SeaFET: 'BaudRate=9600'

• Output data in XML format: 'OutputFormat=2'

• Enable temperature output: 'OutputTemp=Y'

• Set temperature units to °C: 'SetTempUnits=0'

• Enable salinity output: 'OutputSal=Y'

• Enable oxygen output: 'OutputOx=Y'

• Set oxygen units to mg/l: 'SetOxUnits=1'

• Enable pressure output: 'OutputPress=Y'

• Set pressure units to dbar: 'SetPressUnits=0'

• Set pumping parameters: 'AdaptivePumpControl=N, OxNTau=7'

Note: With a typical oxygen sensor response time of OxTau20=5.5 seconds, this results in a pump time of 38.5

seconds (OxNTau * OxTau20 = 7 * 5.5 = 38.5) before each measurement.

• Suppress the '<executed>'tag from the SBE37 responses: OutputExecutedTag=n

Mooring	SeaFET S/N	MicroCAT-ODO S/N	Deployment date	Frequency	Settings

EB1	103	14152	10-03-2017	Every 4 hours starting 00:00 local (01:00 UTC)	Average 30, Burst 1
MAR1	104	14150	19-03-2017	Every 4 hours starting 00:00 local (01:00 UTC)	Average 30, Burst 1
WB1	105	14151	30-03-2017	Every 4 hours starting 00:00 local (01:00 UTC)	Average 30, Burst 1

Table 12.1 SeapHOx deployments sensor specific information

13 Remote Access Samplers (RAS)

Pete Brown & Darren Rayner

13.1 Background

The McLane Research Laboratories Inc. (www.mclane.com) Remote Access Sampler (RAS) 3-48-500 is an instrument for the autonomous collection of seawater samples. It works by pumping water out of the bottom of an acrylic sample cylinder in which an evacuated sample bag is installed. A pressure gradient is created, and the removed volume is replaced by local seawater being pushed into the sample inlet, through a multi-position valve and into the bag. A movement of the valve back to its home position isolates the sample collected until recovery. Pre-injection of a sample preservative into the bag can mean the sample can be stored safely on the instrument indefinitely without compromising sample integrity. The sampler is capable of collecting 48 samples, from a frequency of 3 samples an hour to a deployment period of 18 months.

Four RAS were deployed during DY039 across the subtropical North Atlantic as part of the NERC-funded Atlantic BiogeoChemical (ABC) Fluxes program. This looks to extend the capabilities of the successful RAPID mooring array into a biogeochemical sphere by the use of both autonomous samplers and carbon system sensors (pH, pCO_2).

13.2 Recovery of RAS systems deployed as part of DY039

EB1 – Sampler S/N 13278-05 Deployed 03-11-2015 Recovered 07-03-2017

The system was recovered in a heavily fouled condition. The sample inlet bolt was bent and a large number of tubing fittings missing or broken, indicating single or multiple impacts of some sort, possibly from the mooring chain above. Two valve tubing lines were detached from the bottom of their individual sample bottles – 37 and 'Acid Wash'. These are both on the outside of the RAS situated in separate corners, indicating a possible weakness with regard to these locations. During sample bag removal it was found that only Sample 1 had been collected. All other bags were either empty, or had a few millilitres of water in them (assumed to be the mercuric chloride solution introduced prior to deployment). For sample 1, the bag ripped at the on/off valve fitting during removal. It was thought that this was due to the RAS being located directly in the sun on deck after being brought on to the ship, causing the water and air in the sample bag to expand within the acrylic cylinder, making its removal practically

impossible. The RAS did not respond when communications were attempted, indicating a possible power failure. Testing of the battery voltage showed that it had decreased to 3V remaining. A replacement battery was installed and some data was recovered from the unit. No deployment data or sampling schedule was present in the main system memory. In the EEPROM memory data backup cache, details of a single sampling event (Event 1) was present and indicated a successful sample collection. No other data was present. The pump and valve appeared to be working fine, initially ruling these out as causes of the system failure. Communications with McLane revealed that no previous battery failure had occurred as far as they were aware. Instead they believed that a short existed on the electronics stack causing the total loss of power in the system prior to its second sampling event. Thus, they sent an updated stack to Nassau for collection and testing prior to redeployment of the system at the Western boundary.

MAR1 – Sampler S/N 13278-03 Deployed 12-11-2015 Not recovered

Unfortunately, the top of the mooring at MAR1 had become detached from that below in October 2016, and the beacon was uncommunicative. This meant that this system is assumed lost.

WB1 – Sampler S/N 13278-04 Deployed 30-11-2015 Recovered 28-03-2017

The system was recovered in a heavily fouled condition. On the top side, practically all sample fittings and tubing were still attached in a seemingly undamaged condition. Only compensation tubes at positions 19 and 45 were sheared off. On the bottom side, multiple valve tubing lines were detached from the bottom of their individual sample bottles – 16, 19, 30, 33, 41, 42, 43, 47, 48 and 'Acid Wash'. These were situated both on the inside and outside of the RAS. During sample bag removal it was found that all bags were empty, and the 'Acid Wash' bag still full with deionised water. This indicated that the system had not been able to pump any water from or to the bottom of the acrylic tubes. It was also noted that the valve was stuck between positions 47 and 48. In this case the RAS did respond when communications were attempted. The system informed that a low battery shutdown had occurred whilst trying to collect sample 26. This occurred as battery voltage has dropped below the 18V threshold to 17.9V. However, it indicated that the system had at that point been performing well, turning the valve and running the pump. When the system was taken apart for cleaning, it was found that the tubing between the pump and the valve inlet had become detached, with the fitting still in place but heavily bent. It was assumed that this had occurred either just before or after deployment, and prior to the first sampling event. The tubing would have required a lot of force to be removed and no clear cause was apparent that would solely affect this tube. During setup of a separate system for redeployment at WB1, it was realised that the use of large cable ties to secure the retaining bars was the probable cause of the removal of the tubing from its fitting at the valve. The tie must have been inadvertently located beneath the pump tubing, and when tightened had raised the tubing sufficiently to detach it from its fitting at the valve.

The bottom sensor frame was found to have suffered heavy crevice corrosion. Some parts, in particular the crossbars, will need replacing before redeployment could be possible. On the upper RAS frame, additional corrosion was identified around the mid bars that the main RAS body is attached to, and at the point where the shackle attaches. It was thought that this should not impact the integrity of the frame for

another deployment, and so the top and bottom sections were separated, and the top section prepared for redeployment at WBH2.

On removal of the battery, some water was found within the control module and some corrosion beneath the electronics stack. There didn't appear to be any corrosion on the electronics board itself, and the backup batteries were unaffected. The area was cleaned, the saturated silica gel pouch replaced, and a new battery installed.

WBH2 – Sampler S/N 13278-02 Deployed 24-11-2015 Recovered 31-03-2017

The system was recovered in an almost pristine condition. On both top and bottom sides, all tubing and fittings were still attached in a seemingly undamaged condition. During sample bag removal it was found that as for WB1, all bags were empty and the 'Acid Wash' bag still full with deionised water. Again, this indicated that the system had not been able to pump any water from or to the bottom of the acrylic tubes. The valve was found to be in the Home position. The RAS responded to attempted communication, and indicated that the sampling schedule was being interrupted, meaning that it had successfully completed the previous sampling events up to that point and was still running. Data download found that the battery was still at 27.8V. As for WB1, when the system was taken apart for cleaning, it was found that the tubing between the pump and the valve inlet had become detached, with the fitting still in place, although in this case it was not bent. Due to the lack of samples it was again assumed that this had occurred either just before or after deployment, and the likely cause was the same as that for WB1.

On this unit, substantial crevice corrosion was found on the upper RAS frame, around the mid bars that the main RAS body is attached to. This will require replacement / repair before redeployment is possible. This unit will be returned to Southampton so that a bottom sensor frame can be made for it, to enable all RAS units to be interchangeable between mooring locations.

13.3 Deployment of replacement RAS systems

Mooring	Sampler S/N	Colour code	Deployment date	Last sample to be collected
EB1	14082-01	Green	10-03-2017	15-12-2018
MAR1	13278-01	Blue	19-03-2017	24-12-2018
WB1	13278-05	Red	30-03-2017	19-11-2018
WBH2	13278-04	Yellow	01-04-2017	21-11-2018

Table 13.1 RAS samplers deployed during JC145

Instrument preparation

The NOC Standard Operating Procedure for RAS deployment [*Brown and Rayner*, 2015] was followed during the instrumental setup for all four RAS deployed as part of this trip. In each case the following main considerations were made:

- Controller unit opened, power connected to main circuit board and back-up batteries (2xAAA) installed. Controller housing o-ring checked for dirt and hairs, and cap reinstalled. RAS then connected to PC and woken up.

- Pump test carried out to check correct pumping rate.

- Pressure compensation tubes and fittings were removed from each sample cap to enable filling of sample cylinders.

- Sample bags installed in acrylic cylinders

- Samples lines filled with dilute mercuric chloride as sample preservative

- Acrylic cylinders filled with waters, sample bag on/off valves opened and sample caps secured. Acrylic cylinders back-filled through compensation tube openings

- Sample inlet cap removed, replacement installed and instrument set up to deploy.

Sampling parameters / program

At each specified time-point, the RAS will follow the same schedule of activities:

- Valve turns from Home to Port 49
    - freshwater flush of 10 mL (from freshwater [milliQ] reservoir in bag at port 49)
- Valve turns from 49 to home
    - local seawater flush of 100 mL
- Valve turns from Home to port of sample bag to be filled
    - Local seawater fills sample bag: 500mL
- Valve turns from sample port to Home

The pump works at approximately 70-80 mL/min, meaning the collection of a single sample takes approximately 10 minutes.

A number of deviations from the standard operating procedure were noted for individual mooring deployments. The standard operating procedure has been modified to account for the issues that arose:

13.3.1 EB1 – deployed 10/03/2017

- RAS time and date was set to UTC. Local time was UTC -1.
- Due to the 'Acid wash' blue tubing becoming detached during the initial EB1 deployment, the position of this bottle was switched with that of bottle 46. This was to give it more protection towards the centre of the RAS. It would have been better to move its position with that of 48, but the length of the bottom blue tubing precluded this.
- An orange fisherman's basket was cut into two strips and attach to the top of the RAS with cable ties. This was to protect somewhat the sample inlet and tubing below from the chain.
- Where possible, fittings on RAS were removed and replaced with metric versions.
- During instrumental setup (pump primed, top line filled, bottom lines prefilled, bags added, mercuric chloride added to sample lines, bags opened, acrylic cylinders filled), some air managed to get into the sample lines / push the sample preservative bag. An assessment of the quantity of air in the lines is made below:
-

EB1 Pre-deployment sample line assessment: location of preservative

Sample line	Notes	Sample line	Notes
1	No air in line	26	No air in line
2	~3 cm air in total	27	No air in line
3	No air in line	28	2 small bubbles
4	One tiny bubble	29	No air in line
5	~0.5 cm air in total	30	No air in line
6	No air in line	31	~1cm at valve head
7	1 small bubble	32	No air in line
8	No air in line	33	2 bubbles

9	1 small bubble
10	No air in line
11	1 small bubble
12	1 small bubble
13	1 small bubble
14	1 small bubble
15	No air in line
16	No air in line
17	No air in line
18	No air in line
19	No air in line
20	No air in line
21	No air in line
22	No air in line
23	No air in line
24	No air in line
25	2” at valve head
34	2 bubbles
35	1 bubble
36	No air in line
37	1 tiny bubble
38	No air in line
39	No air in line
40	2 tiny bubbles
41	No air in line
42	No air in line
43	No air in line
44	1” at valve head
45	No air in line
46	No air in line
47	3 bubbles
48	No air in line
49	~3 inches of liquid only in line

Sampling schedule:

First sample on deployment for calibration. Second sample at midnight so that offset can be compared to deployment sample. Further 46 samples at 14 day interval. Therefore, 645 days plus 14 days for replacement RAS to be deployed to continue two-week time series.

Sample number	Date	Time		Sample number	Date	Time	
		Local	UTC			Local	UTC
1	10/03/2017	18:30:00	18:00:00	25	27/01/2018	00:00:00	01:00:00
2	11/03/2017	00:00:00	01:00:00	26	10/02/2018	00:00:00	01:00:00
3	25/03/2017	00:00:00	01:00:00	27	24/02/2018	00:00:00	01:00:00
4	08/04/2017	00:00:00	01:00:00	28	10/03/2018	00:00:00	01:00:00
5	22/04/2017	00:00:00	01:00:00	29	24/03/2018	00:00:00	01:00:00
6	06/05/2017	00:00:00	01:00:00	30	07/04/2018	00:00:00	01:00:00
7	20/05/2017	00:00:00	01:00:00	31	21/04/2018	00:00:00	01:00:00
8	03/06/2017	00:00:00	01:00:00	32	05/05/2018	00:00:00	01:00:00
9	17/06/2017	00:00:00	01:00:00	33	19/05/2018	00:00:00	01:00:00
10	01/07/2017	00:00:00	01:00:00	34	02/06/2018	00:00:00	01:00:00
11	15/07/2017	00:00:00	01:00:00	35	16/06/2018	00:00:00	01:00:00
12	29/07/2017	00:00:00	01:00:00	36	30/06/2018	00:00:00	01:00:00
13	12/08/2017	00:00:00	01:00:00	37	14/07/2018	00:00:00	01:00:00
14	26/08/2017	00:00:00	01:00:00	38	28/07/2018	00:00:00	01:00:00
15	09/09/2017	00:00:00	01:00:00	39	11/08/2018	00:00:00	01:00:00
16	23/09/2017	00:00:00	01:00:00	40	25/08/2018	00:00:00	01:00:00
17	07/10/2017	00:00:00	01:00:00	41	08/09/2018	00:00:00	01:00:00
18	21/10/2017	00:00:00	01:00:00	42	22/09/2018	00:00:00	01:00:00
19	04/11/2017	00:00:00	01:00:00	43	06/10/2018	00:00:00	01:00:00
20	18/11/2017	00:00:00	01:00:00	44	20/10/2018	00:00:00	01:00:00
21	02/12/2017	00:00:00	01:00:00	45	03/11/2018	00:00:00	01:00:00
22	16/12/2017	00:00:00	01:00:00	46	17/11/2018	00:00:00	01:00:00

23	30/12/2017	00:00:00	01:00:00	47	01/12/2018	00:00:00	01:00:00
24	13/01/2018	00:00:00	01:00:00	48	15/12/2018	00:00:00	01:00:00

Table 13.2 EB1 RAS sampling schedule

At time of deployment, final readout of RAS was:

Date	Time	Battery	Temp	Port
03/09/15	22:44:35	33.2 Vb	22.4C	00 (home)

13.3.2 MAR1 – deployed 12/11/2015

- RAS time and date was set to UTC. Local time was UTC -3.
- As for EB1, to avoid the 'Acid wash' blue tubing becoming detached during the deployment, the position of this bottle was switched. In this case, it was with position 48. This way, the wash could be protected at the expense of a sample that it was unlikely would be sampled due to cruise timings.
- An orange fisherman's basket was cut into two strips and attach to the top of the RAS with cable ties. This was to protect somewhat the sample inlet and tubing below from the chain.
- Corrosion was found on the pump fittings. The pump was removed from the system, cleaned and fittings replaced.
- Where possible, fittings on RAS were removed and replaced with metric versions.
- Instrumental setup (pump primed, top line filled, bottom lines prefilled, bags added, mercuric chloride added to sample lines) was begun on 15/03 and mercuric chloride was installed in the evening, finishing at 2100 local. No obvious bubbles were found in any of the sample lines at this point. The following day, water was added to the cylinders, and bubbles were noticed in practically all sample lines both before and after filling. It is thought that this was possibly due to a temperature change from the previous night. An assessment of the quantity of air in the lines prior to the deployment is made below:

MAR1 Pre-deployment sample line assessment: location of preservative

Sample line	Notes	Sample line	Notes
1	~3" in middle	26	No air in line
2	~2" towards valve head	27	No air in line
3	~3" towards valve head	28	~2" towards middle
4	~6" towards sample bottle	29	~3" towards middle
5	~1cm towards sample bottle	30	No air in line
6	~2" in middle	31	~3" towards middle
7	No air in line	32	~2" towards middle
8	1 bubble	33	~2" towards middle
9	1 bubble	34	~2" towards middle, ~1" towards valve head
10	1 bubble	35	~2" towards middle, ~1" towards valve head
11	~2" towards valve head	36	~3" towards middle
12	~2" towards valve head	37	~2cm towards valve head
13	~3" towards valve head	38	~2" towards valve head
14	No air in line	39	~2.5" towards middle
15	~3" towards middle	40	~2" towards middle
16	~2" towards valve head	41	~3" towards valve head
17	~3" towards valve head	42	~3" towards middle
18	No air in line	43	~2" towards valve head

19	~1" towards valve head	44	~2" towards valve head
20	~2" towards middle	45	1 bubble
21	No air in line	46	No air in line
22	~2" towards middle	47	~3" towards valve head
23	~3" towards middle	48	No air in line
24	~3" towards middle	49	Air in line
25	~3" towards middle		

Sampling schedule:

First sample on deployment for calibration. Second sample at 0000 local so that offset can be compared to deployment sample. Further 46 samples at 14 day interval. Therefore, 645 days plus 14 days for replacement RAS to be deployed to continue two week timeseries.

Sample No.	Date	Time		Sample No.	Date	Time	
		Local	UTC			Local	UTC
1	19/03/2017	17:45:00	20:45:00	25	05/02/2018	00:00:00	03:00:00
2	20/03/2017	00:00:00	03:00:00	26	19/02/2018	00:00:00	03:00:00
3	03/04/2017	00:00:00	03:00:00	27	05/03/2018	00:00:00	03:00:00
4	17/04/2017	00:00:00	03:00:00	28	19/03/2018	00:00:00	03:00:00
5	01/05/2017	00:00:00	03:00:00	29	02/04/2018	00:00:00	03:00:00
6	15/05/2017	00:00:00	03:00:00	30	16/04/2018	00:00:00	03:00:00
7	29/05/2017	00:00:00	03:00:00	31	30/04/2018	00:00:00	03:00:00
8	12/06/2017	00:00:00	03:00:00	32	14/05/2018	00:00:00	03:00:00
9	26/06/2017	00:00:00	03:00:00	33	28/05/2018	00:00:00	03:00:00
10	10/07/2017	00:00:00	03:00:00	34	11/06/2018	00:00:00	03:00:00
11	24/07/2017	00:00:00	03:00:00	35	25/06/2018	00:00:00	03:00:00
12	07/08/2017	00:00:00	03:00:00	36	09/07/2018	00:00:00	03:00:00
13	21/08/2017	00:00:00	03:00:00	37	23/07/2018	00:00:00	03:00:00
14	04/09/2017	00:00:00	03:00:00	38	06/08/2018	00:00:00	03:00:00
15	18/09/2017	00:00:00	03:00:00	39	20/08/2018	00:00:00	03:00:00
16	02/10/2017	00:00:00	03:00:00	40	03/09/2018	00:00:00	03:00:00
17	16/10/2017	00:00:00	03:00:00	41	17/09/2018	00:00:00	03:00:00
18	30/10/2017	00:00:00	03:00:00	42	01/10/2018	00:00:00	03:00:00
19	13/11/2017	00:00:00	03:00:00	43	15/10/2018	00:00:00	03:00:00
20	27/11/2017	00:00:00	03:00:00	44	29/10/2018	00:00:00	03:00:00
21	11/12/2017	00:00:00	03:00:00	45	12/11/2018	00:00:00	03:00:00
22	25/12/2017	00:00:00	03:00:00	46	26/11/2018	00:00:00	03:00:00
23	08/01/2018	00:00:00	03:00:00	47	10/12/2018	00:00:00	03:00:00
24	22/01/2018	00:00:00	03:00:00	48	24/12/2018	00:00:00	03:00:00

Table 13.3 MAR1 RAS sampling schedule

At time of deployment, final readout of RAS was:

Date	Time	Battery	Temp	Port
03/18/17	19:04:16	33.1 Vb	26.3°C	00 (home)

13.3.3 WB1 – deployed 30/03/2017

- RAS time and date was set to UTC. Local time was UTC -4.
- As for EB1 & MAR1, to avoid the 'Acid wash' blue tubing becoming detached during the deployment, the position of this bottle was switched. In this case, it was with position 48. This way, the wash could be protected at the expense of a sample that it was unlikely would be sampled due to cruise timings.

- An orange fisherman's basket was cut into two strips and attach to the top of the RAS with cable ties. This was to protect somewhat the sample inlet and tubing below from the chain.
- The position of the pump tubing was checked following final setup and it could be seen that it was correctly located
- Blue tubing of position 2 disconnected during setup. It did not lose any water, so it was reconnected and setup continued
- During opening of on/off bag valve in position 11, bag detached from its fitting to sample cap. Bag was removed as it had become open to air and had lost vacuum. Sample line was removed and refilled and new bag attached.
- Corrosion was found on the pump fittings. The pump was removed from the system, cleaned and fittings replaced.
- Where possible, fittings on RAS were removed and replaced with metric versions.
- During instrumental setup (pump primed, top and bottom lines prefilled, acrylic cylinders 100% filled – no backwards pumping / valve turning), some air managed to get into the sample lines / push the sample preservative bag. An assessment of the quantity of air in the lines is made below:

WB1 Pre-deployment sample line assessment: location of preservative

Sample line	Notes	Sample line	Notes
1	4 small bubbles	26	~3" at valve head
2	No air in line	27	No air in line
3	No air in line	28	1 small bubble
4	1 small bubble	29	~1" at valve head
5	No air in line	30	No air in line
6	No air in line	31	No air in line
7	No air in line	32	~2" at valve head
8	1 small bubble	33	No air in line
9	3 small bubbles	34	1 small bubble
10	No air in line	35	~1cm at valve head
11	1 small bubble	36	No air in line
12	1 bubble & 1cm at valve head	37	No air in line
13	1 bubble	38	No air in line
14	~2" in middle	39	No air in line
15	1 small bubble	40	1 bubble
16	No air in line	41	No air in line
17	2 small bubbles	42	No air in line
18	~1.5" air consisting of multiple tiny bubbles	43	No air in line
19	No air in line	44	No air in line
20	No air in line	45	~1" in middle
21	No air in line	46	1 bubble
22	No air in line	47	4 bubbles
23	~1" at valve head	48	No air in line
24	No air in line	49	~4" in middle
25	~2" at valve head		

Sampling schedule:

First sample on deployment for calibration. Second sample at 0000 local so that offset can be compared to deployment sample. Further 46 samples at 13-day interval. Therefore, 611 days plus 13 days for replacement RAS to be deployed to continue two weekly timeseries.

Sample number	Sampling Date	Time		Sample number	Sampling Date	Time	
		Local	UTC			Local	UTC
1	30/03/2017	19:00:00	23:00:00	25	24/01/2018	00:05:00	04:05:00
2	31/03/2017	00:05:00	04:05:00	26	06/02/2018	00:05:00	04:05:00
3	13/04/2017	00:05:00	04:05:00	27	19/02/2018	00:05:00	04:05:00
4	26/04/2017	00:05:00	04:05:00	28	04/03/2018	00:05:00	04:05:00
5	09/05/2017	00:05:00	04:05:00	29	17/03/2018	00:05:00	04:05:00
6	22/05/2017	00:05:00	04:05:00	30	30/03/2018	00:05:00	04:05:00
7	04/06/2017	00:05:00	04:05:00	31	12/04/2018	00:05:00	04:05:00
8	17/06/2017	00:05:00	04:05:00	32	25/04/2018	00:05:00	04:05:00
9	30/06/2017	00:05:00	04:05:00	33	08/05/2018	00:05:00	04:05:00
10	13/07/2017	00:05:00	04:05:00	34	21/05/2018	00:05:00	04:05:00
11	26/07/2017	00:05:00	04:05:00	35	03/06/2018	00:05:00	04:05:00
12	08/08/2017	00:05:00	04:05:00	36	16/06/2018	00:05:00	04:05:00
13	21/08/2017	00:05:00	04:05:00	37	29/06/2018	00:05:00	04:05:00
14	03/09/2017	00:05:00	04:05:00	38	12/07/2018	00:05:00	04:05:00
15	16/09/2017	00:05:00	04:05:00	39	25/07/2018	00:05:00	04:05:00
16	29/09/2017	00:05:00	04:05:00	40	07/08/2018	00:05:00	04:05:00
17	12/10/2017	00:05:00	04:05:00	41	20/08/2018	00:05:00	04:05:00
18	25/10/2017	00:05:00	04:05:00	42	02/09/2018	00:05:00	04:05:00
19	07/11/2017	00:05:00	04:05:00	43	15/09/2018	00:05:00	04:05:00
20	20/11/2017	00:05:00	04:05:00	44	28/09/2018	00:05:00	04:05:00
21	03/12/2017	00:05:00	04:05:00	45	11/10/2018	00:05:00	04:05:00
22	16/12/2017	00:05:00	04:05:00	46	24/10/2018	00:05:00	04:05:00
23	29/12/2017	00:05:00	04:05:00	47	06/11/2018	00:05:00	04:05:00
24	11/01/2018	00:05:00	04:05:00	48	19/11/2018	00:05:00	04:05:00

Table 13.4 WB1 RAS sampling schedule

At time of deployment, final readout of RAS was:

Date	Time	Battery	Temp	Port
03/30/17	16:11:02	33.2 Vb	26.7°C	00 (home)

13.3.4 WBH2 – deployed 01/04/2017

- RAS time and date was set to UTC. Local time was UTC -4.
- As for EB1, MAR1 & WB1, to avoid the 'Acid wash' blue tubing becoming detached during the deployment, the position of this bottle was switched. In this case, it was with position 48. This way, the wash could be protected at the expense of a sample that it was unlikely would be sampled due to cruise timings.

- An orange fisherman's basket was cut into two strips and attach to the top of the RAS with cable ties. This was to protect somewhat the sample inlet and tubing below from the chain.
- The position of the pump tubing was checked following final setup and it could be seen that it was correctly located
- Corrosion was found on the pump fittings. The pump was removed from the system, cleaned and fittings replaced.
- Where possible, fittings on RAS were removed and replaced with metric versions.
- During instrumental setup (pump primed, top and bottom lines prefilled, acrylic cylinders 100% filled – no backwards pumping / valve turning), some air managed to get into the sample lines / push the sample preservative bag. An assessment of the quantity of air in the lines is made below:

WBH2 Pre-deployment sample line assessment: location of preservative

Sample line	Notes	Sample line	Notes
1	~5" in middle	26	No air in line
2	No air in line	27	No air in line
3	~2" in middle	28	1cm in middle
4	~1" in middle	29	~2" in middle
5	2 bubbles	30	2 bubbles
6	~2" in middle	31	No air in line
7	No air in line	32	~1cm in middle
8	Air fills line apart from ~3" at sample head	33	~1.5" in middle
9	No air in line	34	~1cm in middle
10	0.5 cm in middle	35	~5cm in middle
11	~1cm at valve head	36	~6mm in middle
12	~1" in middle	37	~2" in middle
13	~1" at sample	38	No air in line
14	~1cm in middle	39	~3" at valve head
15	~2" in middle	40	No air in line
16	No air in line	41	~2" in middle
17	1 bubble	42	~1" at valve head
18	~2" at sample	43	No air in line
19	2 bubbles	44	No air in line
20	~1cm in middle	45	~3" at valve head
21	~2cm in middle	46	~2.5" at valve head
22	~1cm in middle	47	~2.5" at valve head
23	40% of tube at sample end	48	1 bubble
24	~1cm in middle	49	Lots of bubbles
25	~2.5" at valve head		

Sampling schedule:

First sample on deployment for calibration. Second sample at 0000 local so that offset can be compared to deployment sample. Further 46 samples at 13-day interval. Therefore, 611 days plus 13 days for replacement RAS to be deployed to continue two weekly timeseries.

Sample Number	Sampling Date	Time		Sample Number	Sampling Date	Time	
		Local	UTC			Local	UTC
1	01/04/2017	18:00:00	22:00:00	25	26/01/2018	00:05:00	04:05:00
2	02/04/2017	00:05:00	04:05:00	26	08/02/2018	00:05:00	04:05:00

3	15/04/2017	00:05:00	04:05:00	27	21/02/2018	00:05:00	04:05:00
4	28/04/2017	00:05:00	04:05:00	28	06/03/2018	00:05:00	04:05:00
5	11/05/2017	00:05:00	04:05:00	29	19/03/2018	00:05:00	04:05:00
6	24/05/2017	00:05:00	04:05:00	30	01/04/2018	00:05:00	04:05:00
7	06/06/2017	00:05:00	04:05:00	31	14/04/2018	00:05:00	04:05:00
8	19/06/2017	00:05:00	04:05:00	32	27/04/2018	00:05:00	04:05:00
9	02/07/2017	00:05:00	04:05:00	33	10/05/2018	00:05:00	04:05:00
10	15/07/2017	00:05:00	04:05:00	34	23/05/2018	00:05:00	04:05:00
11	28/07/2017	00:05:00	04:05:00	35	05/06/2018	00:05:00	04:05:00
12	10/08/2017	00:05:00	04:05:00	36	18/06/2018	00:05:00	04:05:00
13	23/08/2017	00:05:00	04:05:00	37	01/07/2018	00:05:00	04:05:00
14	05/09/2017	00:05:00	04:05:00	38	14/07/2018	00:05:00	04:05:00
15	18/09/2017	00:05:00	04:05:00	39	27/07/2018	00:05:00	04:05:00
16	01/10/2017	00:05:00	04:05:00	40	09/08/2018	00:05:00	04:05:00
17	14/10/2017	00:05:00	04:05:00	41	22/08/2018	00:05:00	04:05:00
18	27/10/2017	00:05:00	04:05:00	42	04/09/2018	00:05:00	04:05:00
19	09/11/2017	00:05:00	04:05:00	43	17/09/2018	00:05:00	04:05:00
20	22/11/2017	00:05:00	04:05:00	44	30/09/2018	00:05:00	04:05:00
21	05/12/2017	00:05:00	04:05:00	45	13/10/2018	00:05:00	04:05:00
22	18/12/2017	00:05:00	04:05:00	46	26/10/2018	00:05:00	04:05:00
23	31/12/2017	00:05:00	04:05:00	47	08/11/2018	00:05:00	04:05:00
24	13/01/2018	00:05:00	04:05:00	48	21/11/2018	00:05:00	04:05:00

Table 13.5 WBH2 RAS sampling schedule

Date	Time	Battery	Temp	Port
04/01/17	12:09:32	33.1 Vb	24.9°C	00 (home)

RAS SYSTEM USAGE

RAS S/N	L4 test	Nov 2015 – Mar 2017	Mar 2017 – Nov 2018
	2 months	16 months	20 months
13278-01	24 samples		MAR1
13278-02		WBH2 (46 samples)	
13278-03		MAR1 – LOST	
13278-04		WB1 (25 samples)	WBH2
13278-05		EB1 (1 sample)	WB1
14082-01			EB1

13.4 References

Brown, P. J., and D. Rayner (2015), Standard operating procedure for the pre-deployment setup of the McLane Remote Access Sampler (RAS)Rep., National Oceanography Centre, Southampton, UK.

Culberson, C.H., 1991. Dissolved oxygen. *WHP Operations and Methods*.

Grasshoff, K., Kremling, K. Ehrhardt, M., 2007. *Frontmatter, in Methods of Seawater Analysis*. Weinheim, Germany: Wiley-VCH Verlag GmbH.

14 Mooring operations and processing

Moorings operations and processing followed the procedures described in previous cruise reports. Lists of moorings recovered and deployed can be found in

Mooring	Latitude	Longitude	Depth (m)	Fall-back (m)	Date	Time anchor drop	Deploy-ment duration
ebh4	27° 51.01	13° 32.40	1056	109	01-Mar	15:49	01:22
ebh4L7	27° 52.15	13° 30.65	993	14	01-Mar	13:31	00:05
ebh3	27° 48.53	13° 44.78	1420	195	02-Mar	12:40	01:38
ebh2	27° 36.89	14° 12.64	2018	No tri.	02-Mar	18:51	00:18
ebh1	27° 13.33	15° 25.35	3039	No tri.	03-Mar	13:55	00:23
ebh1lL2	27° 12.25	15° 25.00	3028	No tri.	03-Mar	11:45	00:10
ebhi	24° 56.21	21° 15.88	4469	No tri.	05-Mar	14:33	00:50
eb1	23° 45.41	24° 09.56	5087	429	10-Mar	17:51	04:46
eb1L12	23° 47.94	24° 08.62	5089	219	09-Mar	17:01	00:25
nog	23° 45.32	41° 05.76	4250	No tri.	14-Mar	15:36	01:28
mar3	23° 52.28	41° 05.37	5067	493	15-Mar	21:59	04:25
mar3L11	23° 51.74	41° 05.88	5071	20	15-Mar	16:01	00:05
mar1	24° 09.94	49° 44.95	5207	423	19-Mar	17:20	04:56
mar1L11	24° 11.93	49° 43.96	5221	167	18-Mar	17:19	00:05
mar0	25° 08.45	52° 01.31	5470	No tri.	20-Mar	14:52	00:25
wb6	26° 29.70	70° 31.40	5493	No tri.	06-Apr	15:44	00:31
wb4	26° 27.06	75° 43.45	4684	404	03-Apr	17:43	04:13
wb4L12	26° 28.78	75° 42.10	4695	235	02-Apr	19:12	00:05
wbh2	26° 28.94	76° 37.48	4755	210	01-Apr	16:14	02:44
wb2	26° 30.80	76° 44.31	3907	480	30-Mar	17:00	03:23
wb2L12	26° 30.19	76° 44.55	3877	106	29-Mar	18:27	00:05

wb1	26° 29.87	76° 48.93	1404	173	30-Mar	21:06	02:18
wbadcp	26° 31.82	76° 52.00	610	10	28-Mar	17:48	00:06
wbaL7	26° 32.26	76° 51.99	617	48	28-Mar	21:37	00:06

Table 14.3 and Table 14.2.

14.1 Moorings problems

The upper section of MAR1 was lost during the 18-month deployment. The mooring collapsed in October 2016 when the wire parted above the 175m MicroCAT. All instruments above this section were lost and the break is thought to have been caused by drifting longline fishing gear as this has been seen in the past at the MAR sites.

A mix up on the deployment cruise meant that the syntactic buoy at 5000m depth on WB6 was far over its depth rating and as such this was crushed. There was no other buoyancy at the top of the mooring (aside from a small pickup float) so the instruments laid on the seabed for the duration of the deployment. With the crushed float still attached to the mooring line and little reserve buoyancy, the whole mooring took approximately 24 hours to surface.

The lander at WBAL5 would not surface despite confirmed operation of both acoustic releases. The reason is unknown, but given the previous experience of the lander at the same site losing it's buoyancy above the lander frame not long after deployment it is thought this could have happened to the WBAL5 lander too. The replacement design was changed to use chain between the lander and the buoyancy rather than polypropylene rope.

There were a lot of glass implosions/write-offs from the recovered moorings. Around 22 were imploded and about 40 were deemed unusable on inspection for spalling and cracking of the glass.

14.2 Instrument problems

Whilst setting up for the first cal dip, MicroCAT sn 7469 was giving low battery warnings despite new batteries being fitted. This needs to be investigated further.

A number of MicroCATs were out of spec or had problems with calibrations and these are detailed in the cal dip summary (Table 14.5). A few of the least bad had to be deployed on moorings EBH2 and EBH1 as there was insufficient water depth to do a repeat cal dip prior to these moorings.

Three MicroCATs had their connectors broken during the drag recovery of the CTD frame, and as a result these all flooded. No data were lost as these were on a pre-deployment cal dip, but because of the age of these instruments they are now written off.

MicroCAT 3212 on EBH4 had a large drop in the conductivity readings after approximately 4 months and doesn't recover. There is still variability in the signal, but with what looks like an offset and/or scaling error.

On recovery MicroCAT 3904 had a low battery warning flag and the sample number had reset to zero. The sample number counter was moved to roughly where the end of the record should be (as found from the other MicroCATs on the mooring) and the download was started. The data went up to December 2016, so the record is a few months short, but not what the sample number counter was suggesting.

MicroCAT 6827 didn't collect any data on cal dip 11 as it had a flat battery following recovery from the array. Unfortunately this was redeployed on MAR1 before the lack of data was spotted. The Matlab routines used to check cal dips had a bug that was labelling another instrument as 6827 in the legend. This bug should now have been corrected for future cruises.

Two MicroCATs depleted their batteries a couple of months early (details in the instrument record length Table 14.4), and one flooded on mooring MAR0 (serial number 3259).

The Seagauge BPR 0391 from EB1L had a flat battery and no data on the instrument. This is believed to have been a battery short rather than a flat battery unless the data were wiped after a battery ran flat during the deployment. SBE53 BPR serial number 0085 from MAR1L has what looks like a fault with the pressure sensor part way through the deployment. It is not a clear drop at a point in time, but it varies differently to the other BPR on this lander, and the previously recovered landers from the 2015 DY039 cruise.

The ADCP on WB4 suffered a low-pressure flood approximately 1 month into the deployment shorting the battery. This instrument was added to WB4 to measure the currents above the mooring when knocked down by the Deep Western Boundary Current, but as the mooring suffered no significant knockdown the 1-month of data only had 1 valid depth bin so is not useful.

Similarly the ADCP recovered from WBADCP had a short record, stopping after only a week. This was at first thought to be caused by a battery short, but this instrument has had problems before so this will be investigated further.

One Nortek Aquadopp (serial number 6088) recovered from WB4 suffered with apparent data corruption. A few days of data was downloaded, but these was from before the instrument was in the water. The filesize in the software suggested there was more data than was downloaded so it was thought that some bad data were interrupting the download process. An attempt

The S4 current meter recovered from MAR3 collected no data and the reason could not be determined on the cruise. This is an old instrument and probably won't be used again.

The ABC fluxes sensors are covered in greater detail in sections 1112, but a brief summary is given below.

Two of the three new Deep SeapHOxes were initially not outputting any data from the attached ODOs. This was tracked down to the MicroCAT ouput format being set incorrectly for the SeaFET to interpret (this despite having come from the manufacturer). The format was set to "converted engineering" instead of

"XML" so the "SetOutputFormat=2" command was used to rectify this through the ctdterm section of the SeaFET Comm software.

Of the two recovered SeapHOxes one was flooded (likely through crevice corrosion of the probe cup holder as previously warned by the supplier – a fault that has been fixed for the new instruments) so no data were recoverable for both the pH sensor and the paired MicroCAT ODO. The second recovered SeapHOx had a flat battery due to incorrect setup – again this was expected for this instrument after reviewing the setups during the deployment cruise. Unfortunately the ODO is slaved to the SeaFET, so when the SeaFET stopped it also stopped the collection of oxygen data.

The two recovered Contros Hydro-Cs also had major problems: one had no data and nothing on the memory card at all including firmware (subsequently diagnosed as a failed card by Contros), and the other had very large data gaps sporadically through the record with only 89 days of data collected through the 18-month deployment. The cause for this has not yet been found, but Contros are investigating.

Three of four McLane RAS-500s were recovered (1 lost on MAR1), but no sampled were successfully collected from any of them. The instrument from the top of EB1 had an electronics failure after what looked like one sample being drawn – this sample was subsequently lost when the bag tore on removing it from the sample tube. This unit was serviced and redeployed later in the cruise, with the manufacturer sending out a new electronics stack to the ship during the Bahamas port call. The units from WBH2 and WB1 collected no samples despite the electronics and pump appearing to operate correctly. Closer inspection revealed the pump plumbing tube had been accidentally snagged and disconnected by cable ties added to the frame before deployment – the RAS units deployed after this fault was discovered were carefully checked before deployment.

14.3 Change to deployment locations

On at 16:07 during CTD cast the cable snapped when the package was at a depth of XXX m. in addition to the usual sensors on the frame it was carrying 24 microcats for calibration and 8 releases were being tested prior to deployment.

The CTD was retrieved from 23° 47.75 N 24° 06.78 W and a large amount of cable was left behind at this location. This is more than 2 miles from the site of EB1 but close previous lander deployments. It is therefore recommended to change the lander deployment sites as described in Table 14.1

Small changes were also made to the deployment sites of WB4 and WBAL. Details are also given in Table 14.1.

Lander	Latitude (°N)	Longitude (°W)	Notes
CTD	23° 47.75	24° 06.78	Location where CTD was lost
eb1L10	23°47.48	24° 06.55	Location of lander recovery during JC145
eb1Leven	23°48.00	24° 08.50	Target position used for eb1L12 and recommended for future even deployments
eb1L11	23°48.01	24° 07.14	Location of deployment during DY039. To be recovered in 2018
eb1Lodd	23°48.00	24° 09.50	Recommended target position for future odd deployments
WB4	26° 27.00	75° 43.50	Previous site was a little too shallow for the mooring
WBAL	26° 32.25	76° 51.91	Chosen to be deeper and away fomr unrecovered instruments

Table 14.1 Changes to deployment locations

Mooring	Deployment cruise	Deployment data	Recovery data	Recovery duration (hh:mm)
ebh4	dy039	2015-10-28	2017-03-01	01:38
ebh4L5	jc103	2014-05-31	2017-03-01	00:54
ebh3	dy039	2015-10-27	2017-03-02	01:50
ebh2	dy039	2015-10-28	2017-03-02	01:05
ebh1	dy039	2015-10-29	2017-03-03	01:50
ebh1L10	jc103	2014-05-24	2017-03-03	01:00
ebhi	dy039	2015-10-31	2017-03-05	02:02
ebhiM	dy039	2015-10-31	2017-03-05	04:18
eb1	dy039	2015-11-03	2017-03-07	04:03
eb1L10	jc103	2014-05-24	2017-03-06	01:28
nog	dy039	2015-11-09	2017-03-14	03:00
mar3	dy039	2015-11-08	2017-03-14	04:21
mar3L9	jc103	2014-05-18	2017-03-15	01:58
mar1	dy039	2015-11-12	2017-03-18	05:53
mar1L9	jc103	2014-05-14	2017-03-17	01:17
mar0	dy039	2015-11-13	2017-03-20	02:44
wb6	dy039	2015-11-19	2017-04-06	25:05
wb4	dy039	2015-11-22	2013-04-02	04:46
wb4L10	jc103	2014-05-01	2013-04-02	01:53
wbh2	dy039	2015-11-24	2017-03-31	03:36
wb2	dy039	2015-11-30	2017-03-29	03:02
wb2L10	jc103	2014-05-02	2017-03-29	01:45
wb1	dy039	2015-11-30	2017-03-28	02:43
wbadcp	dy039	2015-11-24	2017-03-28	00:37

Table 14.2 Mooring recovery table

Mooring	Latitude	Longitude	Depth (m)	Fall-back (m)	Date	Time anchor drop	Deploy-ment duration
ebh4	27° 51.01	13° 32.40	1056	109	01-Mar	15:49	01:22
ebh4L7	27° 52.15	13° 30.65	993	14	01-Mar	13:31	00:05
ebh3	27° 48.53	13° 44.78	1420	195	02-Mar	12:40	01:38
ebh2	27° 36.89	14° 12.64	2018	No tri.	02-Mar	18:51	00:18
ebh1	27° 13.33	15° 25.35	3039	No tri.	03-Mar	13:55	00:23
ebh1lL2	27° 12.25	15° 25.00	3028	No tri.	03-Mar	11:45	00:10
ebhi	24° 56.21	21° 15.88	4469	No tri.	05-Mar	14:33	00:50
eb1	23° 45.41	24° 09.56	5087	429	10-Mar	17:51	04:46
eb1L12	23° 47.94	24° 08.62	5089	219	09-Mar	17:01	00:25
nog	23° 45.32	41° 05.76	4250	No tri.	14-Mar	15:36	01:28
mar3	23° 52.28	41° 05.37	5067	493	15-Mar	21:59	04:25
mar3L11	23° 51.74	41° 05.88	5071	20	15-Mar	16:01	00:05
mar1	24° 09.94	49° 44.95	5207	423	19-Mar	17:20	04:56
mar1L11	24° 11.93	49° 43.96	5221	167	18-Mar	17:19	00:05
mar0	25° 08.45	52° 01.31	5470	No tri.	20-Mar	14:52	00:25
wb6	26° 29.70	70° 31.40	5493	No tri.	06-Apr	15:44	00:31
wb4	26° 27.06	75° 43.45	4684	404	03-Apr	17:43	04:13
wb4L12	26° 28.78	75° 42.10	4695	235	02-Apr	19:12	00:05
wbh2	26° 28.94	76° 37.48	4755	210	01-Apr	16:14	02:44
wb2	26° 30.80	76° 44.31	3907	480	30-Mar	17:00	03:23
wb2L12	26° 30.19	76° 44.55	3877	106	29-Mar	18:27	00:05
wb1	26° 29.87	76° 48.93	1404	173	30-Mar	21:06	02:18
wbadcp	26° 31.82	76° 52.00	610	10	28-Mar	17:48	00:06
wbaL7	26° 32.26	76° 51.99	617	48	28-Mar	21:37	00:06

Table 14.3 Mooring deployment table.

Mooring	Nominal depth (m)	Inst. code	Serial number	Mean pressure (dbar)	Start date	End date	No. records	Comments
	100	337	3257	104.3	28/10/15	01/03/17	11760	
	175	337	3893	179.9	28/10/15	01/03/17	11760	
	250	337	6817	256.2	28/10/15	01/03/17	11760	
	325	337	6818	326.5	28/10/15	01/03/17	11760	
	400	337	5766	404.5	28/10/15	01/03/17	11760	
	500	337	6332	505.9	28/10/15	01/03/17	11760	
	600	337	5238	608	28/10/15	01/03/17	11760	
	700	337	3266	712.6	28/10/15	01/03/17	11760	
	800	310	516	812.4	28/10/15	01/03/17	11760	C bad (constant 39)
	800	337	3212	813.6	28/10/15	01/03/17	11760	Large drop in C after 4 months, doesn't recover to previous level
	1000	337	3216	1017.2	28/10/15	01/03/17	11760	
	993	465	395	1021.1	01/06/14	01/03/17	24107	First few records removed as strong drift
	993	465	33	1019.5	31/05/14	01/03/17	24121	
	50	337	3890	49.7	27/10/15	02/03/17	11801	
	100	337	6832	100.5	27/10/15	02/03/17	11801	
	175	337	5765	175.1	27/10/15	02/03/17	11801	
	250	337	6816	250.5	27/10/15	02/03/17	11802	
	325	337	3244	354	27/10/15	02/03/17	11801	
	400	337	3912	428.7	27/10/15	02/03/17	11801	
	500	310	443	508.3	27/10/15	02/03/17	11801	

	500	337	6833	508.1	27/10/15	02/03/17	11802	
	600	337	5772	612.9	27/10/15	02/03/17	11802	
	700	337	5245	709.8	27/10/15	02/03/17	11802	
	800	310	428	820.1	27/10/15	02/03/17	11800	1 gap
	800	337	3252	822.9	27/10/15	02/03/17	11802	
	950	337	3213	964.9	27/10/15	02/03/17	11802	
	1000	310	426	1019.3	27/10/15	02/03/17	11801	
	1100	337	3249	1113.3	27/10/15	02/03/17	11802	
	1200	337	3207	1224.4	27/10/15	02/03/17	11802	
	1300	310	518	1330	27/10/15	02/03/17	11801	
	1400	337	3907	1423.8	27/10/15	02/03/17	11802	
	1600	337	3265	1609.3	28/10/15	02/03/17	11780	
	1800	337	3271	1824.8	28/10/15	02/03/17	11781	
	1900	310	519	1933.5	28/10/15	02/03/17	11782	C bad (constant 32)
	2000	337	3214	2037.1	28/10/15	02/03/17	11781	
	3032	465	414	3085.9	29/05/14	03/03/17	24201	
	3032	465	30	3084.2	30/05/14	03/03/17	24189	First few records removed as high drift
	2500	337	3220	2526	29/10/15	03/03/17	11774	
	2900	310	444	2976.4	29/10/15	03/03/17	11775	
	3000	337	3251	3074	29/10/15	03/03/17	11775	
	3500	337	7470	3537.2	31/10/15	05/03/17	11773	
	4000	337	7362	4054.9	31/10/15	05/03/17	11773	
	4400	370	12700	4459.4	31/10/15	05/03/17	23576	

	4500	337	4799	4563.2	31/10/15	05/03/17	11780	
	5087	465	391					No data. Suspected battery short.
	5087	465	38	5191.6	28/05/14	06/03/17	24312	
	50	383	13278-05					No valid samples collected
	50	348	1114-001					No data recorded (SD card corrupted)
	50	375	4		03/11/15	07/03/17		
	50	337	6827	42.5	03/11/15	07/03/17	10171	stopped early Jan (99 gaps)
	100	337	11744	90.7	03/11/15	07/03/17	11753	
	175	337	6831	161.9	03/11/15	07/03/17	11753	
	250	337	6823	237.4	03/11/15	07/03/17	11753	
	325	337	6841	313.7	03/11/15	07/03/17	11753	
	400	337	6839	393	03/11/15	07/03/17	11753	
	400	335	12832	393.5	03/11/15	07/03/17	11753	C jump in 01/2017
	600	337	7681	593.7	03/11/15	07/03/17	11753	
	800	337	6112	783.8	03/11/15	07/03/17	11753	
	800	335	12833	794.4	03/11/15	07/03/17	11753	
	1000	337	3916	996	03/11/15	07/03/17	11752	
	1200	337	6122	1201.2	03/11/15	07/03/17	11753	
	1500	310	451	1516.3	03/11/15	07/03/17	11753	
	1500	335	12834	1509.7	03/11/15	07/03/17	11753	possible O jump in 12/2015
	1600	337	3206	1612.6	03/11/15	07/03/17	11753	
	2000	337	6113	2011.1	03/11/15	07/03/17	11753	
	2000	335	12835	2022	03/11/15	07/03/17	11753	

	2500	337	3215	2530.6	03/11/15	07/03/17	11753	
	3000	337	3256	3044.5	03/11/15	07/03/17	11753	
	3500	337	5777	3560	03/11/15	07/03/17	11753	
	3500	335	12900	3557.4	03/11/15	07/03/17	11753	O drift
	4000	337	3224	4070.2	03/11/15	07/03/17	11753	
	4500	337	3253	4574	03/11/15	07/03/17	11753	
	4990	310	450	5093.3	03/11/15	07/03/17	11753	
	5000	337	3222	5105.6	03/11/15	07/03/17	11753	
	50	337	3281	8.5	08/11/15	15/03/17	11826	
	100	337	3904	53	08/11/15	30/12/16	10023	bat ran out; T,C noisy 05-10/2016
	180	337	11424	136.5	08/11/15	15/03/17	11826	
	225	337	3905	213.8	08/11/15	15/03/17	11825	C spike 02/2015
	330	337	3233	291.9	08/11/15	15/03/17	11826	
	405	337	6810	369.2	08/11/15	15/03/17	11826	
	600	337	4721	571.9	08/11/15	15/03/17	11826	
	800	337	3228	787.7	08/11/15	15/03/17	11825	
	1000	337	6834	990.5	08/11/15	15/03/17	11826	
	1200	337	3221	1197.2	08/11/15	15/03/17	11826	
	1500	310	507	1511.6	08/11/15	15/03/17	11826	
	1600	337	4795	1613.3	08/11/15	15/03/17	11826	
	2000	337	3255	2017.9	08/11/15	15/03/17	11826	
	2500	337	4475	2529.6	08/11/15	15/03/17	11826	
	3000	337	5984	3042.6	08/11/15	15/03/17	11826	

	3500	337	5776	3551.5	08/11/15	15/03/17	11826	Spike in P at end
	4000	337	5979	4071.2	08/11/15	15/03/17	11826	
	4500	337	6118	4576.4	08/11/15	15/03/17	11826	
	5000	337	3484	5093.6	08/11/15	15/03/17	11826	
	5000	302	4E+07					No data. No comms. on recovery
	5038	465	57	5136.7	19/05/14	14/03/17	24720	
	5038	465	64	5136.1	19/05/14	14/03/17	24720	
	5100	465	85	5329.6	15/05/14	17/03/17	24885	Strange signa. Doesn't match 0419 or previous overlapping lander
	5100	465	419	5332.2	15/05/14	17/03/17	24885	
	50	337	7723					LOST
	50	348	0412-020					LOST
	50	375	2					LOST
	50	383	13278-03					LOST
	100	337						LOST
	175	337	3269	389.9	12/11/15	18/03/17	11799	Lost moor top 10/2016; drop to 900db
	250	337	6802	431.7	12/11/15	18/03/17	11799	dropped to 800 dbar
	325	337	5789	482.2	12/11/15	18/03/17	11799	dropped to 800 dbar
	400	337	4719	529.8	12/11/15	18/03/17	11799	dropped to 800 dbar
	400	335	12901	530.8	12/11/15	18/03/17	11798	dropped to 800 dbar
	600	337	6838	671.3	12/11/15	18/03/17	11799	dropped to 850 dbar
	800	337	3901	792.1	12/11/15	18/03/17	11799	this and lower sensors drop a few dbar
	800	335	12902	791.6	12/11/15	18/03/17	11798	

	1000	337	5783	1000.4	12/11/15	18/03/17	11799	
	1200	337	3229	1198.7	12/11/15	18/03/17	11799	
	1500	310	515	1502.6	12/11/15	18/03/17	11798	
	1500	335	12907	1501.5	12/11/15	18/03/17	11798	O2 lin-exp
	1600	337	3234	1607.2	12/11/15	18/03/17	11799	
	2000	337	4714	2018.7	12/11/15	18/03/17	11799	
	2000	335	12908	2017	12/11/15	18/03/17	11798	O2 lin-exp
	2500	337	6836	2530.7	12/11/15	18/03/17	11799	
	3000	337	6829	3041.3	12/11/15	18/03/17	11799	
	3500	337	3932	3554.7	12/11/15	18/03/17	11799	
	3500	335	12910	3555.9	12/11/15	18/03/17	11798	O2 lin-exp
	4000	337	6811	4072	12/11/15	18/03/17	11799	
	4500	337	6799	4582.7	12/11/15	18/03/17	11799	
	5000	337	3900	5091.9	12/11/15	18/03/17	11799	
	5100	302	4E+07	5182.8	12/11/14	18/03/17	11799	
	4780	337	3247	4723.2	13/11/15	20/03/17	11820	
	4960	337	6800	4913.9	13/11/15	20/03/17	11820	
	5141	337	3259					flooded
	5320	337	6830	5298.4	13/11/15	20/03/17	11820	
	5440	302	4E+07	5430.3	13/11/15	20/03/17	11820	
	5513	337	3225	5547.8	13/11/15	20/03/17	11820	
	50	337	3239	79.1	30/11/15	28/03/17	11612	Large knockdown Oct. 2016
	100	370	9247	115.4	30/11/15	28/03/17	23224	

	100	337	5985	119.1	30/11/15	28/03/17	11612	
	400	337	4072	414.3	30/11/15	28/03/17	11612	
	400	370	6723	412.7	30/11/15	28/03/17	23224	
	400	335	12911	413.3	30/11/15	28/03/17	2902	
	700	328	5575	446.5	30/11/15	28/03/17	11599	Pressure sesnor off, some questionable bins
	700	328	15579	808.3	30/11/15	28/03/17	11600	some questionable bins
	800	337	6123	810.9	30/11/15	28/03/17	11612	
	800	335	13000	811.9	30/11/15	28/03/17	2902	
	800	370	5879	815.5	30/11/15	28/03/17	23224	
	50	337	4180	58.3	30/11/15	29/03/17	11636	A few cond dropouts ~Oct 2016
	100	370	9213	107.8	30/11/15	29/03/17	23273	
	100	337	4470	111.1	30/11/15	29/03/17	11637	
	175	370	9435	180.4	30/11/15	29/03/17	23273	
	180	337	3223	181.2	30/11/15	29/03/17	11636	
	325	337	3232	332.8	30/11/15	29/03/17	11636	
	400	370	8483	408.5	30/11/15	29/03/17	23273	
	500	337	6814	512	30/11/15	29/03/17	11636	
	700	337	6121	714	30/11/15	29/03/17	11636	
	800	370	8052	815.4	30/11/15	29/03/17	23273	
	900	337	6803	916.3	30/11/15	29/03/17	11636	Cond and Temp drops between knockdown events
	1100	337	3270	1117.1	30/11/15	29/03/17	11636	
	1200	370	8492	1228.6	30/11/15	29/03/17	23273	

	1300	337	6137	1326.3	30/11/15	29/03/17	11636	
	1500	370	11024	1537.1	30/11/15	29/03/17	23273	
	1500	337	6808	1533.9	30/11/15	29/03/17	11636	
	1700	337	4068	1735.7	30/11/15	29/03/17	11636	
	1900	337	6821	1937.8	30/11/15	29/03/17	11636	
	2050	370	6534	2088.5	30/11/15	29/03/17	23273	
	2300	337	5782	2347.2	30/11/15	29/03/17	11636	
	2800	337	6128	2852.3	30/11/15	29/03/17	11636	
	3000	370	6747	3080.5	30/11/15	29/03/17	23273	
	3300	337	6325	3363.8	30/11/15	29/03/17	11636	
	3850	337	6335	3902.6	30/11/15	29/03/17	11636	strong exp-linear drift in pressure
wbadcp_12_205	590	324	10311	168.2	15/11/17	23/11/17	197	failed after 8 days
	1500	370	6805	1563.5	24/11/15	31/03/17	23657	
	1500	335	12967	1565.2	24/11/15	31/03/17	2957	spike at start of O2 record
	2000	335	12968	2068.7	24/11/15	31/03/17	2957	spike at start of O2 record
	2200	370	8502	2278.8	24/11/15	31/03/17	23657	
	2200	337	6822	2276.2	24/11/15	31/03/17	11829	
	3000	370	9420	3085.3	24/11/15	31/03/17	23657	
	3000	337	6326	3081.4	24/11/15	31/03/17	11829	
	3500	335	12998	3581.6	24/11/15	31/03/17	2957	spike@start and little variability in O2
	3800	370	9204	3883.4	24/11/15	31/03/17	23657	
	3805	337	5239	3879.7	24/11/15	31/03/17	11829	
	4300	337	5983	4380	24/11/15	31/03/17	11829	

	4600	370	9210	4694.8	24/11/15	31/03/17	23657	
	4690	337	5982	4766.3	24/11/15	31/03/17	11829	
	5087	465	393	3954.8	02/05/14	29/03/17	25483	Clock offset by 730 days
	5087	465	14	3954.4	02/05/14	29/03/17	25485	
	5087	465	39	4776.5	01/05/14	02/04/17	25603	
	5087	465	40	4776.2	01/05/14	02/04/17	25603	
	50	337	4723	64	22/11/15	02/04/17	11918	
	50	335	12999	65.1	23/11/15	02/04/17	2979	
	100	370	5490	105.8	22/11/15	02/04/17	23836	
	100	337	4724	109.8	22/11/15	02/04/17	11918	
	200	324	5599					
	250	337	5243	324.1	22/11/15	02/04/17	11918	Slipped on wire near October 2016
	400	370	5611	412.5	22/11/15	02/04/17	23836	
	405	337	4070	414	22/11/15	02/04/17	11918	
	405	335	12962	414.7	23/11/15	02/04/17	2979	
	600	337	4071	614.3	22/11/15	02/04/17	11918	
	800	370	5889	816.9	22/11/15	02/04/17	23836	
	805	337	5784	820.5	22/11/15	02/04/17	11918	
	805	335	12963	816.8	23/11/15	02/04/17	2979	
	1000	337	6117	1014	22/11/15	02/04/17	11918	
	1200	370	5831	1234.4	22/11/15	02/04/17	23836	
	1205	337	5981	1223.2	22/11/15	02/04/17	11918	
	1500	370	5893	1530.5	22/11/15	02/04/17	23836	

	1500	335	12964	1520.1	23/11/15	02/04/17	2979	
	1600	337	4471	1620.7	22/11/15	02/04/17	11918	
	2000	370	5955	2032.7	22/11/15	02/04/17	23836	
	2005	337	3282	2021	22/11/15	02/04/17	11918	
	2005	335	12965	2028.5	23/11/15	02/04/17	2979	exp-linear oxygen
	2505	337	4464	2529.6	22/11/15	02/04/17	11918	
	3000	370	5963	3100.4	22/11/15	02/04/17	23836	
	3005	337	6804	3054.5	22/11/15	02/04/17	11918	
	3505	337	6798	3564.7	22/11/15	02/04/17	11918	
	3505	335	12966	3566.8	23/11/15	02/04/17	2979	
	4000	370	6050	4080.6	22/11/15	02/04/17	23836	
	4005	337	3913	4080.6	22/11/15	02/04/17	11918	
	4500	337	6824	4586.2	22/11/15	02/04/17	11918	
	4600	370	6088					Corrupted file
	4800	337	6801	5607.2	19/11/15	05/03/17	11318	Cond spikes. Collapsed to 5600 dbar
	4975	337	6127	5603.1	19/11/15	05/03/17	11318	
	5150	337	6826	5603.6	19/11/15	05/03/17	11318	
	5320	337	5770	5610	19/11/15	05/03/17	11318	Spikes in cond
	5440	370	8120	5607	19/11/15	05/03/17	22635	
	5491	337	6322	5592.9	19/11/15	05/03/17	11318	All Microcats show exp-linear drift
	5499	465	80	5608.2	19/11/15	05/03/17	11317	
	5499	465	59	5608.2	19/11/15	05/03/17	11317	

Table 14.4 Mooring instrument record lengths.

Instrument codes used by processing scripts:

302 = InterOcean S4
310 = Aanderaa RCM11
330 = RBR Solo-T
335 = SeaBird MicroCAT SMP-ODO
337 = SeaBird MicroCAT SMP or IMP
348 = Contros Hydro-C pCO2
370 = Nortek Aquadopp
375 = Satlantic/SeaBird SeapHOx
383 = McLane RAS-500
465 = SeaBird SBE26 or SBE53 BPR

Cast 1	6815, 6805, 5786, 5787, 6124, 6125, 6320, 6331, 6806, 6812, 5978, 5980, 5986, 3219, 5988, 5989	
	6805	P ok when moved to 1400m
	6125	C > +0.03 mS/cm different. Had to use anyway.
	6812	Bad pressure sensor
	3219	C > +0.03 mS/cm different. P greatly over-reading at all depths.
Cast 2	5990, 4062, 5991, 5993, 4060, 7361, 5992, 5763, 6321, 5781, 6323, 7363, 4549, 6840, 3248, 4066	
	4060	C > +0.025mS/cm different. Had to use anyway.
	5781	P really far out at all depths
	4066	C > +0.03 mS/cm different. Had to use anyway.
Cast 4	10519, 10545, 10517, 10547, 10546, 10518, 14114, 14115, 14148, 10520, 10542, 10543, 10544, 10555, 14117, 10556, 14147, 14149, 14145, 14146, 7468, 6828, 6819, 5246	
	7468	C +0.035 from 6819/5246. P within 2 at 4500, 4000, 3500
	6828	C +0.01 from CTD, P +3 at 4500
	6819	C -0.005 from CTD, P -9 from CTD at 4000 (using anyway)
	5246	C -0.005, P -12 at 3500 (using anyway)
Cast 6	5244, 5242, 3230, 4179, 3209, 5775, 4710, 5785, 5779, 5780, 6115, 6126, 5485, 6129, 6820, 6825, 6327, 6333, 3933, 3919, 3277, 3268, 3254, 4178	
		Nb No CTD data so all calibrations relative to other microcats
	5244	Flooded during CTD dragging operation
	5242	Higher P than others at bottom, but ok nearer surface. Estimating 0.03mS/cm high for C,
	6126	Possibly over-reading for C,
	6129	flooded during CTD dragging operation
	3919	flooded during CTD dragging operation
Cast 7	3902, 4797, 3486, 4800, 3264, 3911, 3483, 3928, 4305, 3910, 3934, 5773, 4306, 7470, 7362, 4799, 3251, 5768, 4307, 5484, 5762, 3265, 3271, 3214	
	4306	ok at 600 dbar or deeper
	4799	ok (>=2500 dbar)
	3251	ok (>=2500 dbar)
	5768	ok (>=2500 dbar)
	4307	ok 1650 dbar or shallower
	5484	ok between 1650 and 600 dbar (inclusive)
	5762	ok at 4500, 5000 dbar
	3265	ok (>=2500 dbar)
	3271	ok (>=2500 dbar)
	3214	ok between 1650 and 600 dbar (inclusive)

Cast 9	3209, 3230, 3254, 3257, 3268, 3277, 3893, 3933, 4178, 4179, 4710, 5485, 5775, 5779, 5780, 5785, 6115, 6126, 6327, 6333, 6817, 6818, 6820, 6825	
	3257	ok 1200 dbar and shallower
	3268	ok 400 dbar and deeper
	3893	ok 800 dbar and deeper
	4178	C 0.02 low
	4710	ok 3000 dbar and shallower
	5485	ok 1200 dbar and deeper
	5775	C 0.18 low
	5779	ok 1800 dbar and shallower
	5785	ok 3000 dbar and shallower
	6115	ok 2000 dbar and shallower
	6126	C 0.022 high, P 7 low 4600 dbar and deeper
	6817	ok 1200 dbar and shallower
	6818	ok 1800 dbar and shallower
Cast 11	3207, 3212, 3213, 3216, 3244, 3249, 3252, 3266, 3890, 3907, 3912, 5238, 5245, 5765, 5766, 5772, 6332, 6816, 6823, 6827, 6831, 6832, 6833, 11744	
	3207	ok shallower than 1900dbar
	3212	>3mS/cm low (as expected from mooring data)
	3213	ok shallower than 1900dbar
	3216	ok shallower than 1900dbar
	3244	ok shallower than 1900dbar
	3249	ok shallower than 1200dbar
	3252	ok 3600-900dbar
	3266	ok deeper than 600dbar
	3890	ok shallower than 600dbar
	3912	ok shallower than 1200dbar
	5238	ok deeper than 1800dbar
	5765	ok shallower than 1800dbar
	5766	ok shallower than 3600dbar
	5772	ok shallower than 3000dbar
	6816	ok shallower than 1900dbar
	6827	no data - flat battery, but mistakenly redeployed with new battery before re-dipping
	6831	ok shallower than 1200dbar
	6833	ok shallower than 1200dbar
	11744	>2mS/cm high
Cast 13	3206, 3215, 3224, 3229, 3234, 3253, 3256, 3916, 4468, 5777, 5783, 6112, 6113, 6122, 12832, 12833, 12834, 12835, 12900, 12901, 12902, 12907, 12908, 12910	
	3206	P ok 3200 and shallower
	3215	C 0.25 high

	3229	P ok 4000 and shallower
	3234	P ok 2400 and shallower
	3253	P ok 1800 and shallower
	3916	P ok 1800 and shallower
	5777	P ok 2400 and shallower
	5783	P ok 1800 and shallower
	6112	P 11 to 12 low throughout
	6113	ok at 5000 and deeper (~ 6dbar at 3000m)
	12832	C bad (>1 psu low); O > 5 high compared to group
	12907	C bad (>1 psu low); O > 5 high compared to group
Cast 14	3222, 5984, 5776, 5979, 6118, 3484, 3932, 6811, 6799, 3900, 4714, 6836, 6829, 3281, 3904, 11424, 3905, 3233, 6810, 4721, 3228, 6834, 3221, 4795	
	6118	ok between 700 and 4600 dbar
	3484	ok deeper than 550 dbar
	3932	C +0.03mS/cm. P, T ok
	6811	ok deeper than 400 dbar
	3900	ok between 200 and 5200 dbar
	6836	C +0.025mS/cm. P ok deeper than 1830 dbar
	3281	Bad conductivity. Data from mooring looks ok though.
	3904	C +0.04mS/cm. P ok shallower than 1680dbar
	11424	C +0.025mS/cm. P, T ok
	3905	C +0.025mS/cm. P ok shallower than 2140dbar
	3233	ok shallower than 1200dbar
	6810	C +0.025mS/cm. P ok deeper than 900dbar
	4721	ok shallower than 3000dbar
	3228	C +0.025mS/cm. P ok shallower than 2000dbar
	6834	ok shallower than 2330dbar
	3221	ok shallower than 2660dbar
	4795	ok shallower than 2630dbar
Cast 15	3255, 4475, 6841, 6839, 7681, 3269, 6802, 5789, 6838, 3901, 3247, 6800, 6830, 3225	
	3255	ok shallower than 3880dbar
	6841	ok shallower than 2800dbar
	6839	ok shallower than 1500dbar
	3269	C 0.35mS/cm low
	5789	ok between 500 and 2500dbar
	3901	ok shallower than 1780dbar
Cast 19	3239, 5985, 4072, 6123, 6120, 4180, 4470, 3223, 3232, 6814, 6121, 6803, 3270, 6137, 6808, 4068, 6821, 5782, 6128, 6325, 6335	
	3239	Wrapped pressure
	4072	Wrapped pressure
	4470	Cond high: 0.06

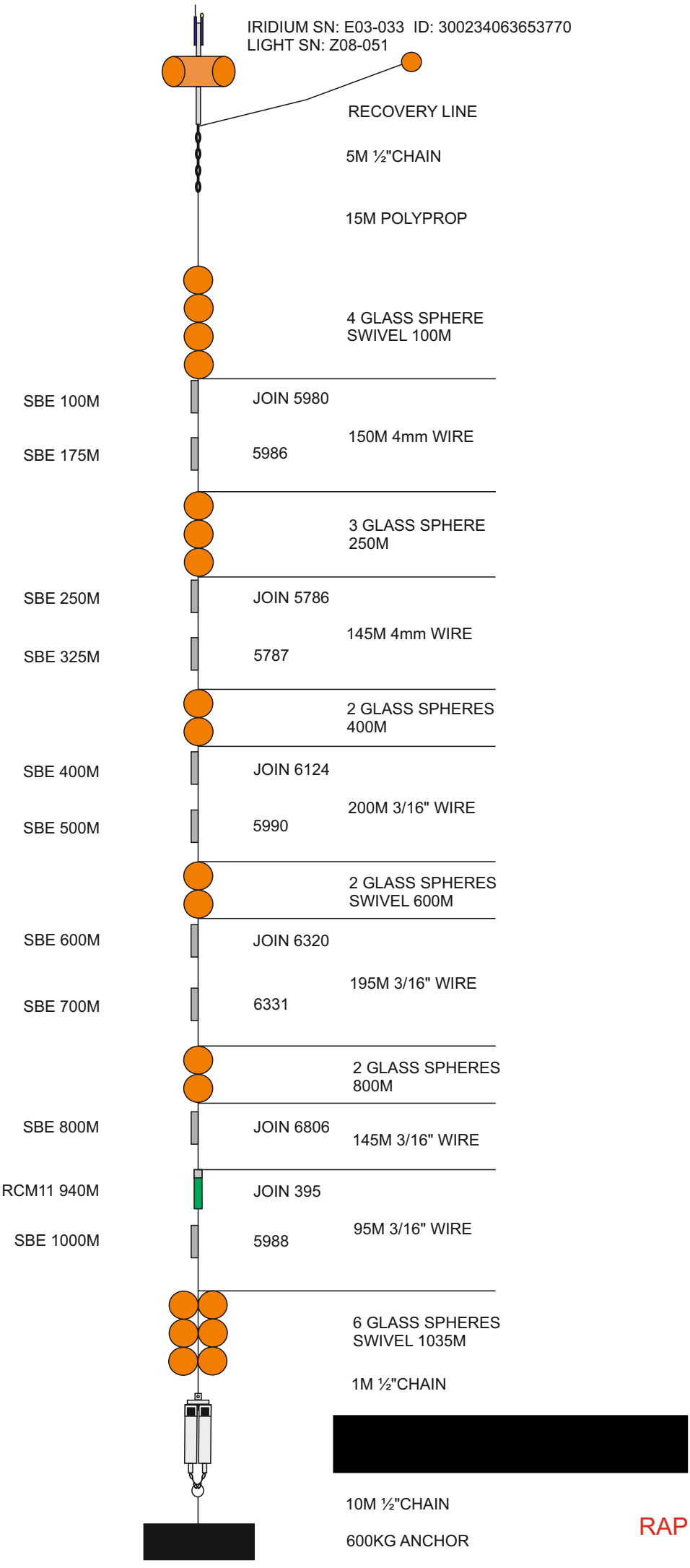
	3223 4068	Cond high: 0.06 Wrapped pressure
Cast 21	6822, 6326, 5239, 5983, 5982	
Cast 24	12999, 12962, 12963, 12964, 12965, 12966, 12967, 12968, 12998, 12911, 13000, 3220, 4719	
Cast 25	4723, 4724, 5243, 4070, 4071, 5784, 6117, 5981, 4471, 3282, 4464, 6804, 6798, 3913, 6824	
Not dipped	6801, 6127, 6826, 5770, 6322, 4071	

Table 14.5 Details of instruments calibrated on CTD casts.

Appendix A: Diagrams of deployed moorings

EBH4 DEPLOYED 2017

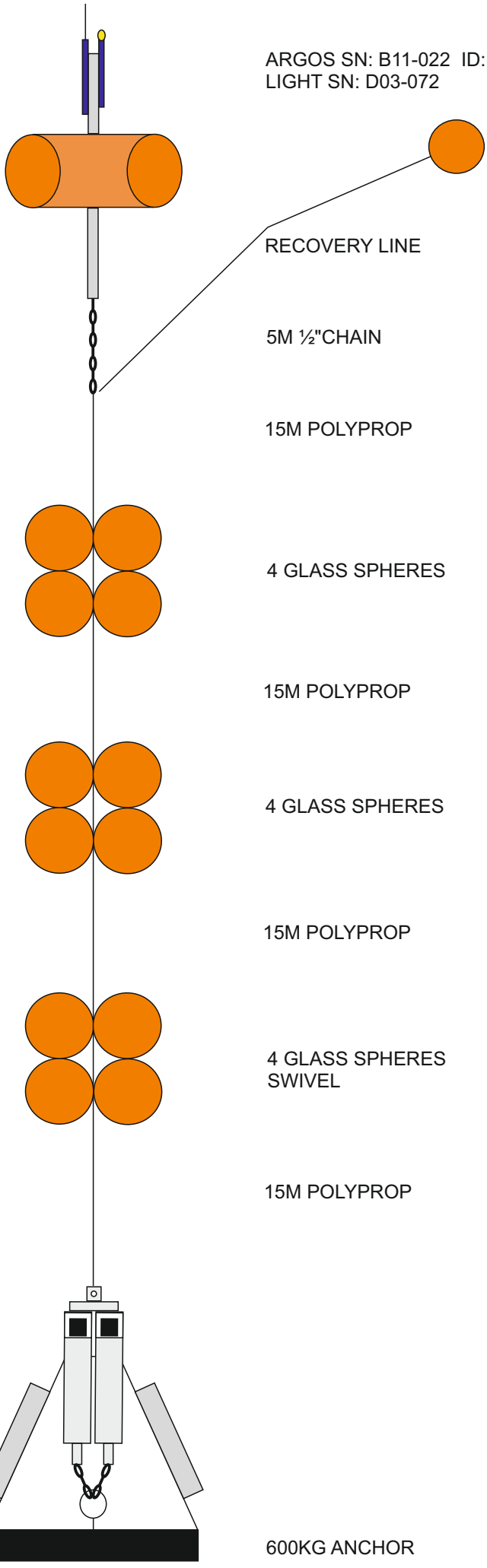
DATE: 01/03/2017
POSN: 27° 51.06'N
13° 32.36'W
DEPTH: 1056m



RAPID WATCH

EBH4L7
DEPLOYED

DATE: 01/03/2017
POSN: 27° 52.15'N
13° 30.65'W
DEPTH: 993m



ARGOS SN: B11-022 ID: 134363
LIGHT SN: D03-072

RECOVERY LINE

5M ½"CHAIN

15M POLYPROP

4 GLASS SPHERES

15M POLYPROP

4 GLASS SPHERES

15M POLYPROP

4 GLASS SPHERES
SWIVEL

15M POLYPROP

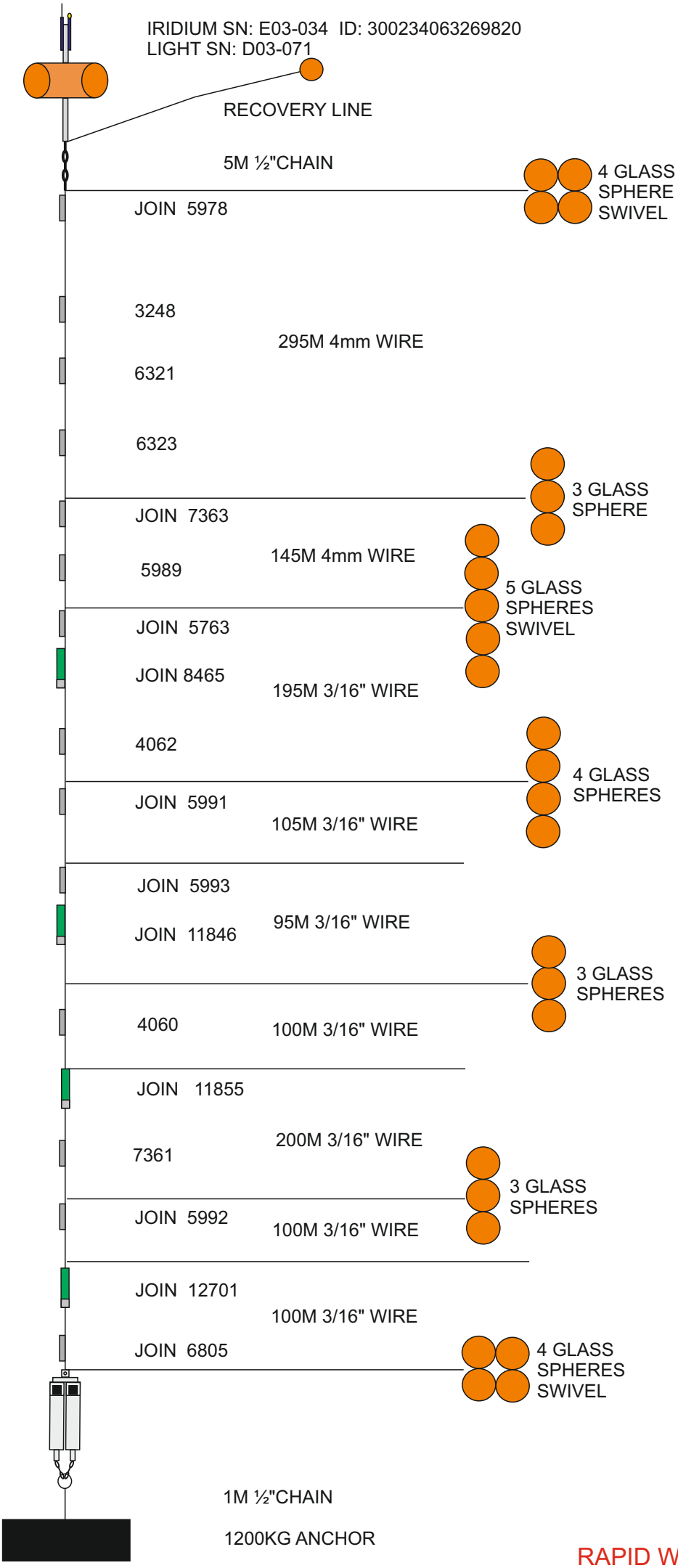
STAINLESS FRAME
2 OFF BPR'S
SN: 53-0447
SN: 53-0003

600KG ANCHOR

RAPID WATCH

EBH3 DEPLOYED 2017

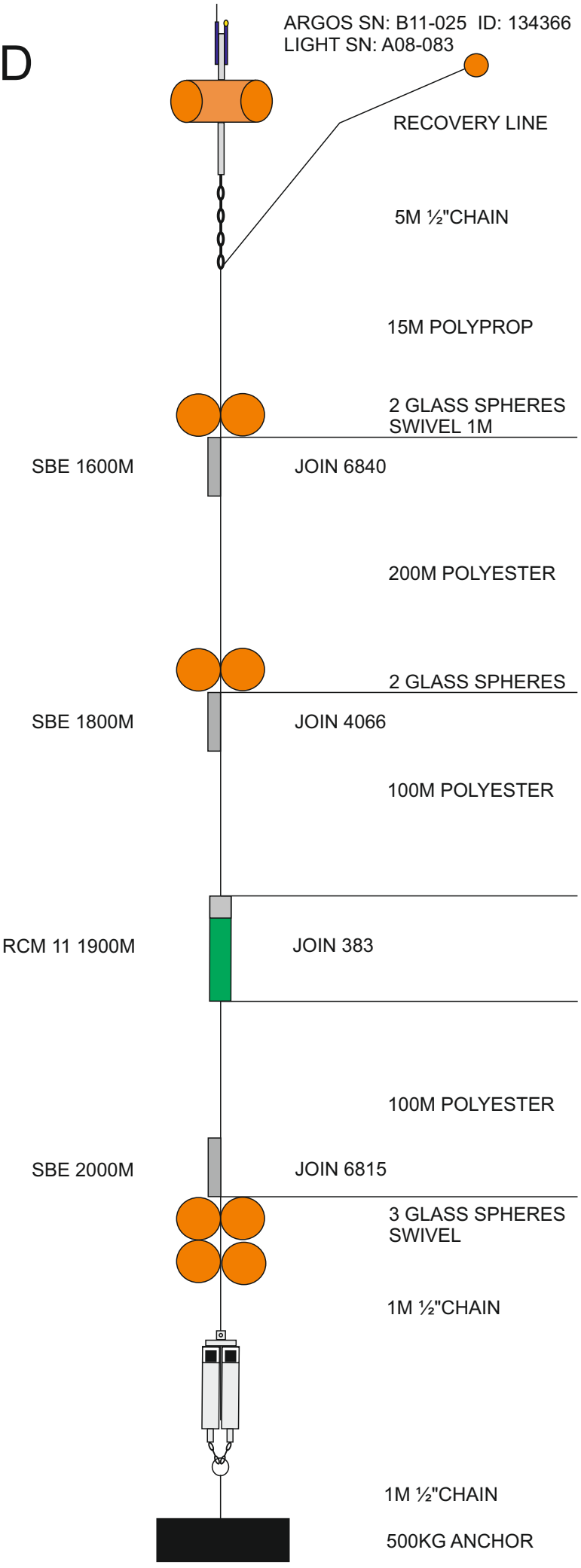
DATE: 02/03/2017
POSN: 27° 48.61'N
13° 44.72'W
DEPTH: 1420m



RAPID WATCH

EBH2 DEPLOYED 2017

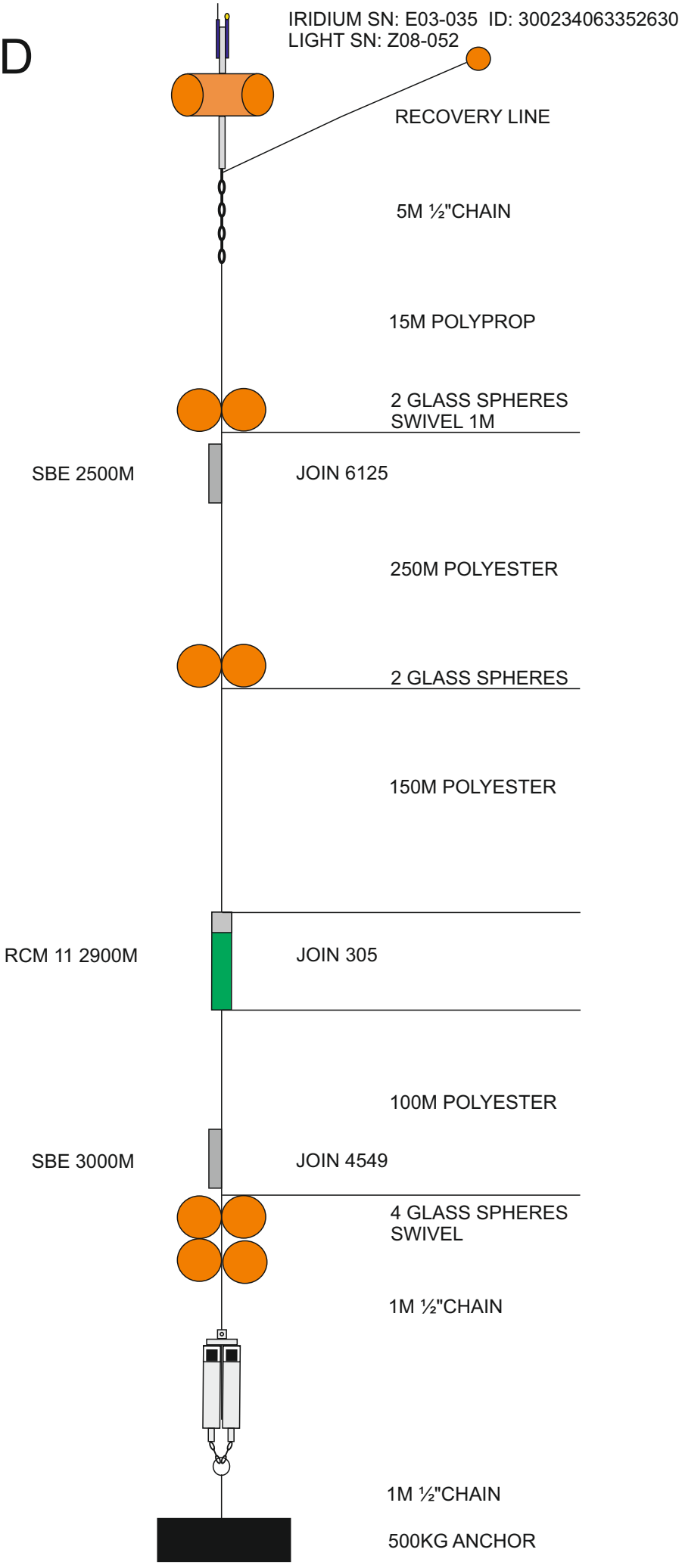
DATE: 02/03/2017
POSN: 27° 36.90'N
14° 12.64'W
DEPTH: 2018m



RAPID WATCH

EBH1 DEPLOYED 2017

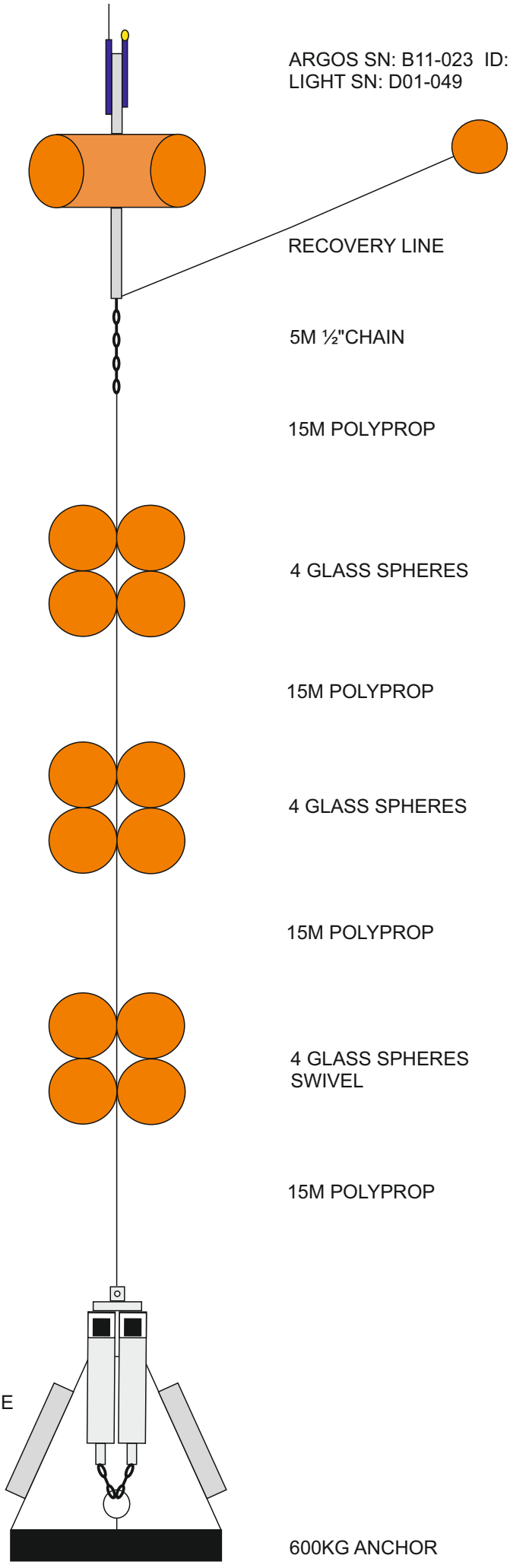
DATE: 03/03/2017
POSN: 27° 13.33'N
15° 25.36'W
DEPTH: 3039m



RAPID WATCH

EBH1L12 DEPLOYED 2017

DATE: 03/03/2017
POSN: 27° 12.25'N
15° 25.01'W
DEPTH: 3031m



ARGOS SN: B11-023 ID: 134364
LIGHT SN: D01-049

RECOVERY LINE

5M ½"CHAIN

15M POLYPROP

4 GLASS SPHERES

15M POLYPROP

4 GLASS SPHERES

15M POLYPROP

4 GLASS SPHERES
SWIVEL

15M POLYPROP

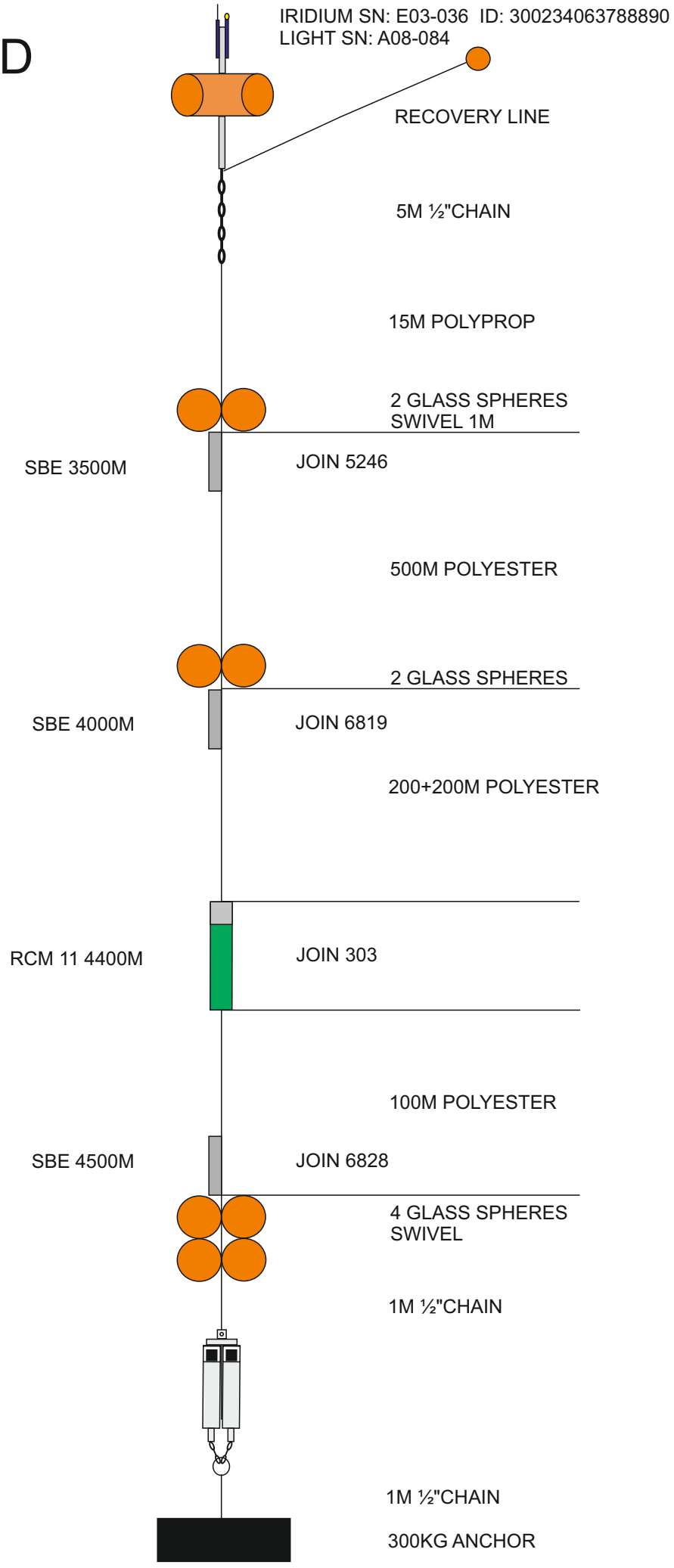
STAINLESS FRAME
2 OFF BPR'S
SN: 53-0004
SN: 53-0448

600KG ANCHOR

RAPID WATCH

EBHi DEPLOYED 2017

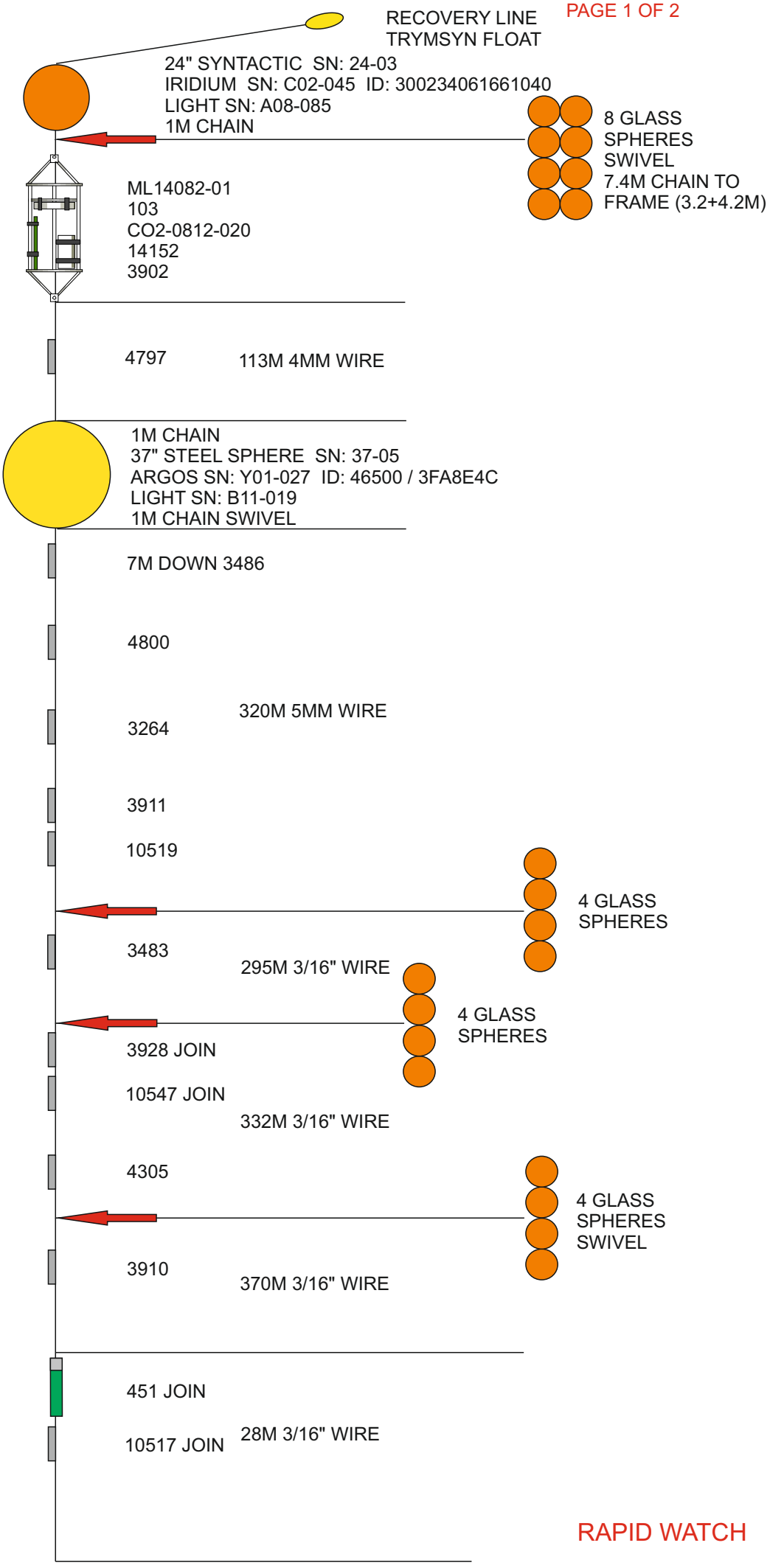
DATE: 05/03/2017
POSN: 24° 56.21'N
21° 15.88'W
DEPTH: 4497m



RAPID WATCH

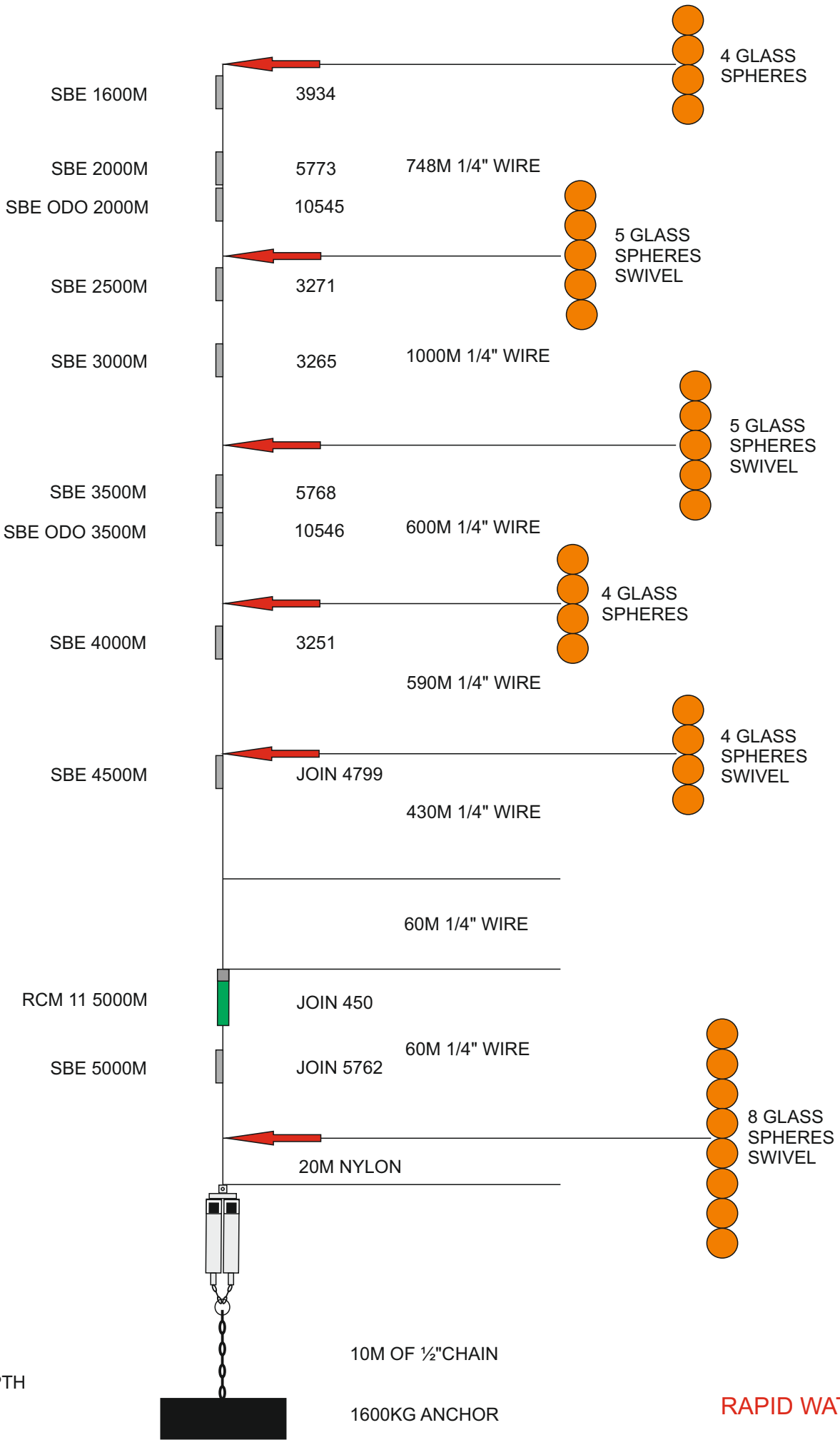
EB 1 DEPLOYED 2017

DATE: 10/03/2017
POSN: 23° 45.64'N
24° 09.44'W
DEPTH: 5087m



RAPID WATCH

EB 1 DEPLOYED 2017

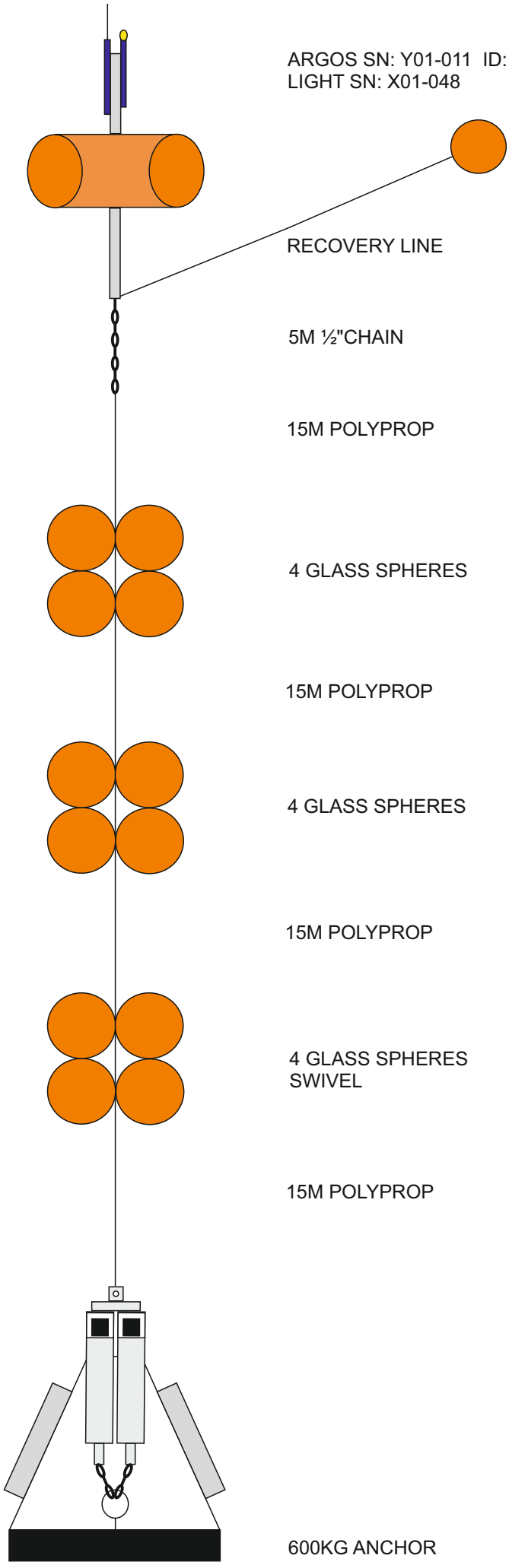


WATER DEPTH
5087M

RAPID WATCH

EB1L12 DEPLOYED 2017

DATE: 09/03/2017
POSN: 23° 48.00'N
24° 8.50'W
DEPTH: 5089m



ARGOS SN: Y01-011 ID: 46493 / 3FA28D4
LIGHT SN: X01-048

RECOVERY LINE

5M ½"CHAIN

15M POLYPROP

4 GLASS SPHERES

15M POLYPROP

4 GLASS SPHERES

15M POLYPROP

4 GLASS SPHERES
SWIVEL

15M POLYPROP

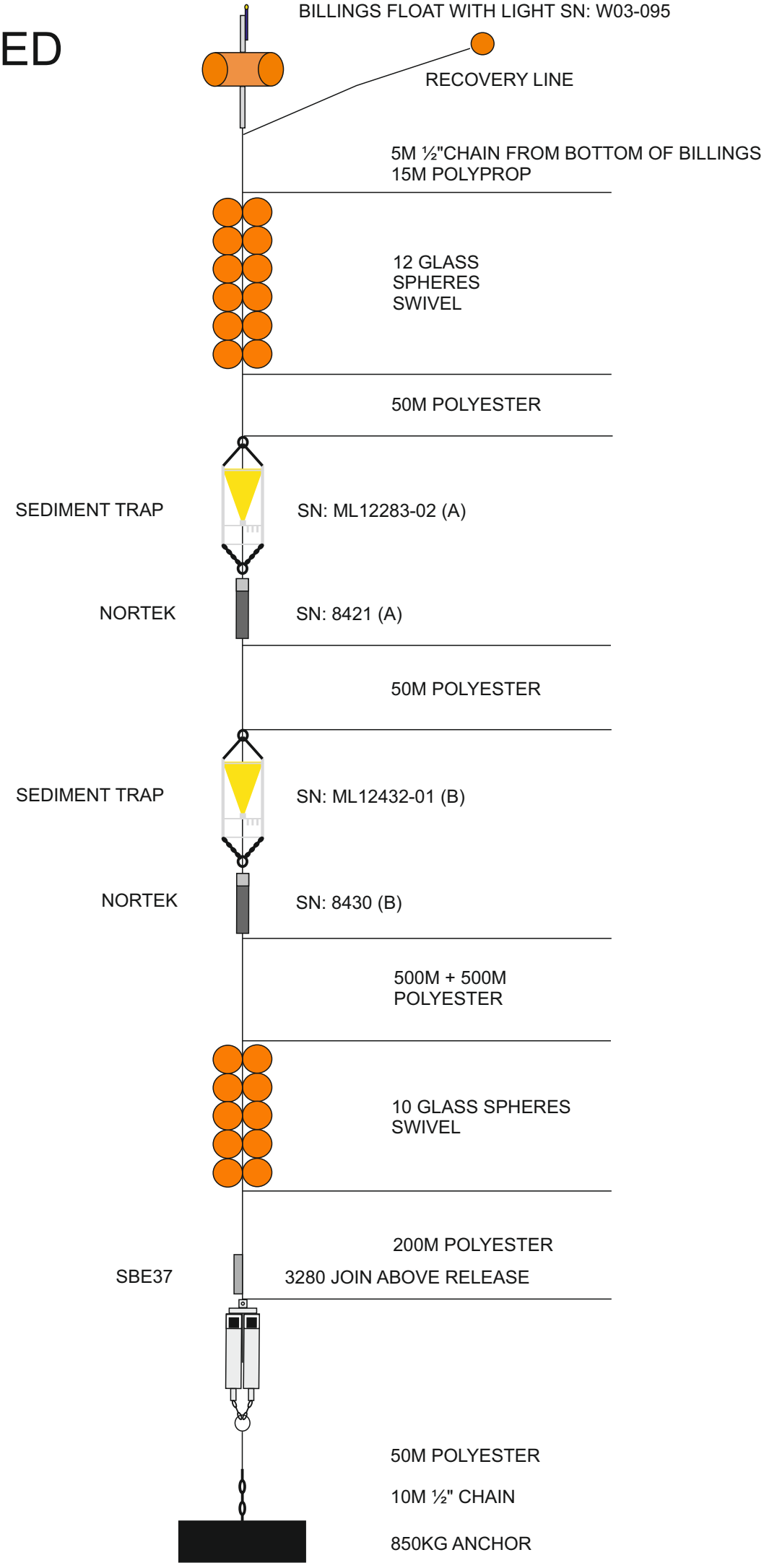
2 OFF BPR'S
SN: 53-0449
SN: 53-0435

600KG ANCHOR

RAPID WATCH

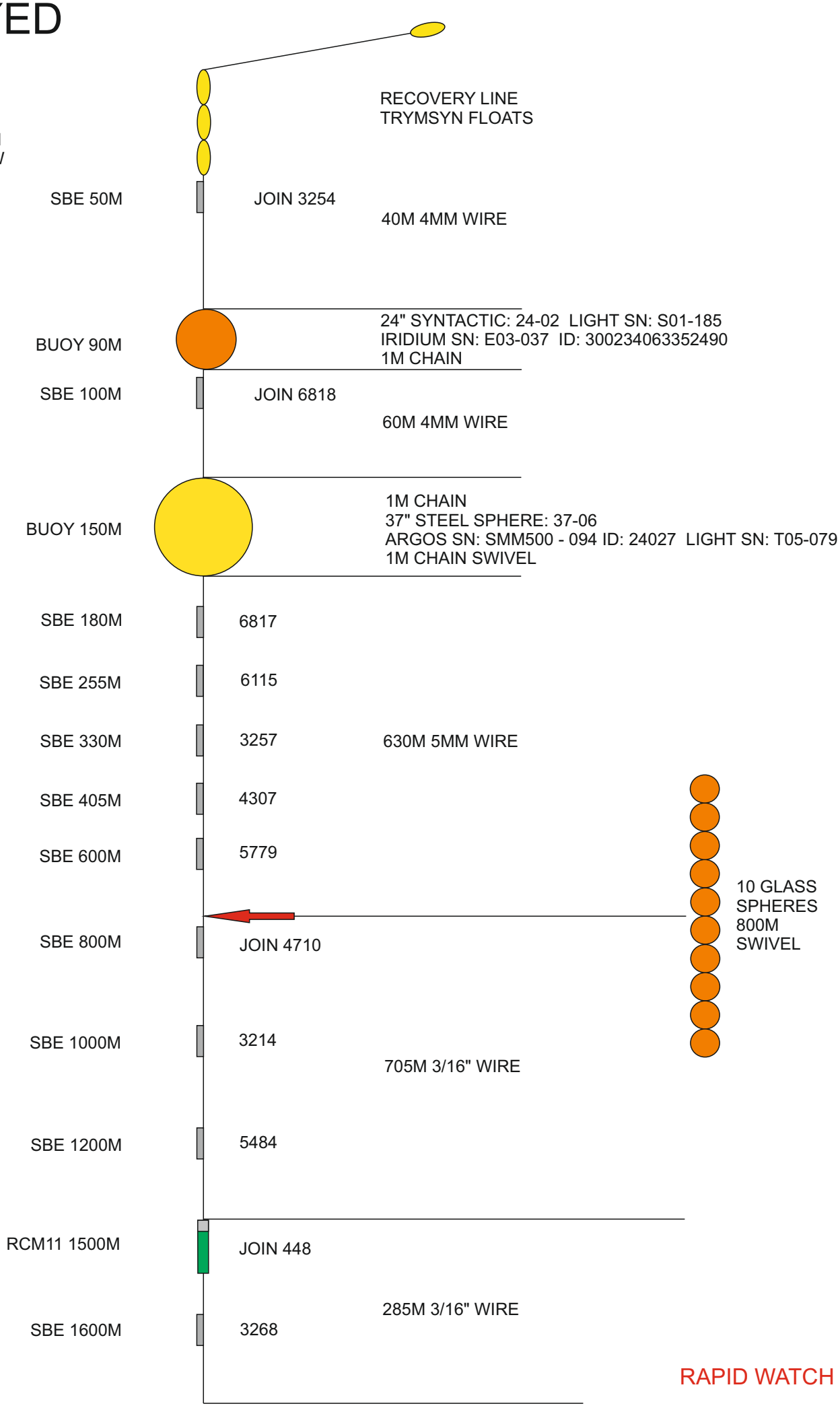
NOG DEPLOYED 2017

DATE: 14/03/2017
POSN: 23° 45.33'N
41° 05.74'W
DEPTH: 4598m



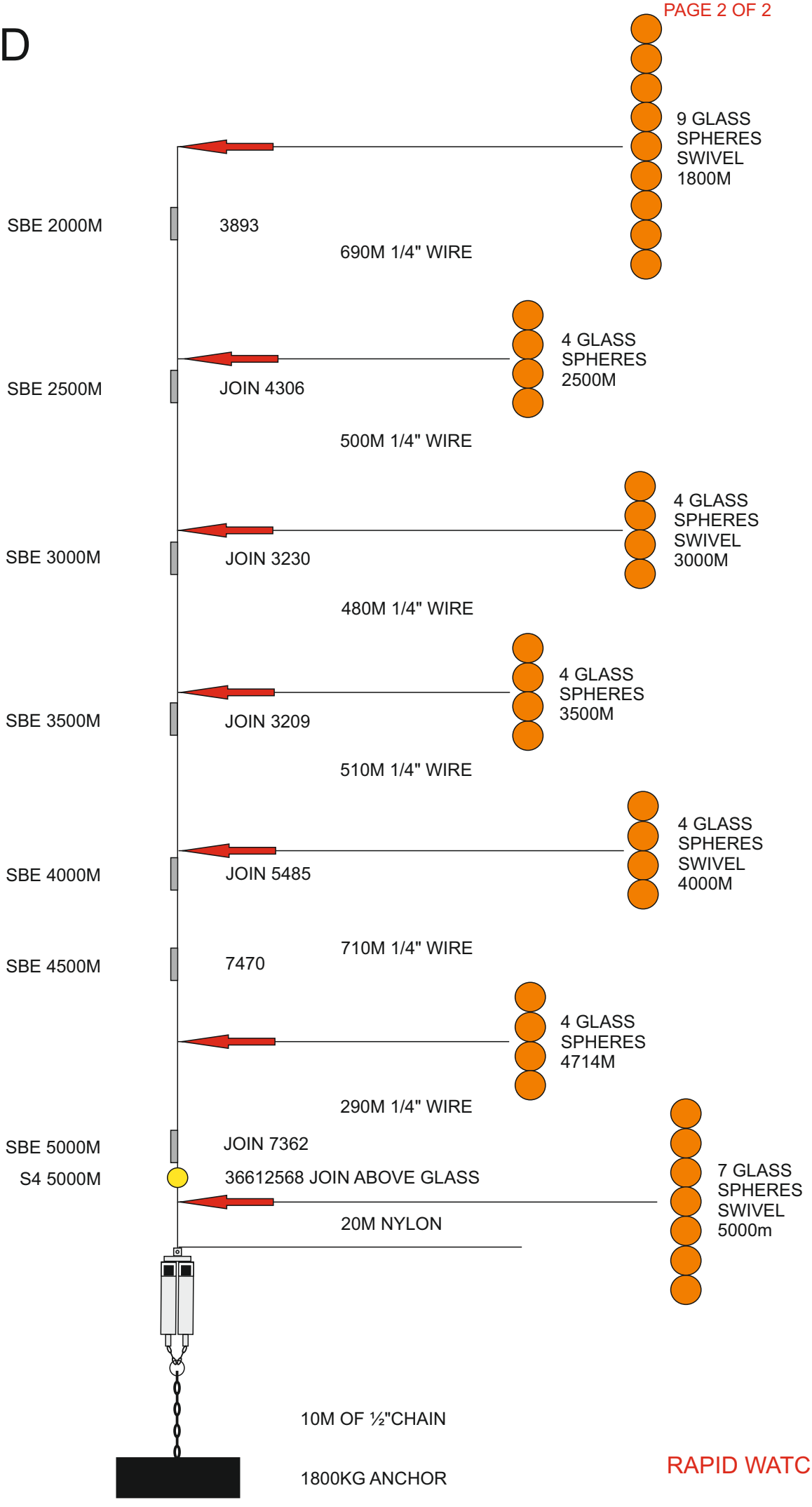
MAR 3 DEPLOYED 2017

DATE: 15/03/2017
POSN: 23° 52.35'N
41° 05.08'W
DEPTH: 4980m



RAPID WATCH

MAR 3 DEPLOYED 2017

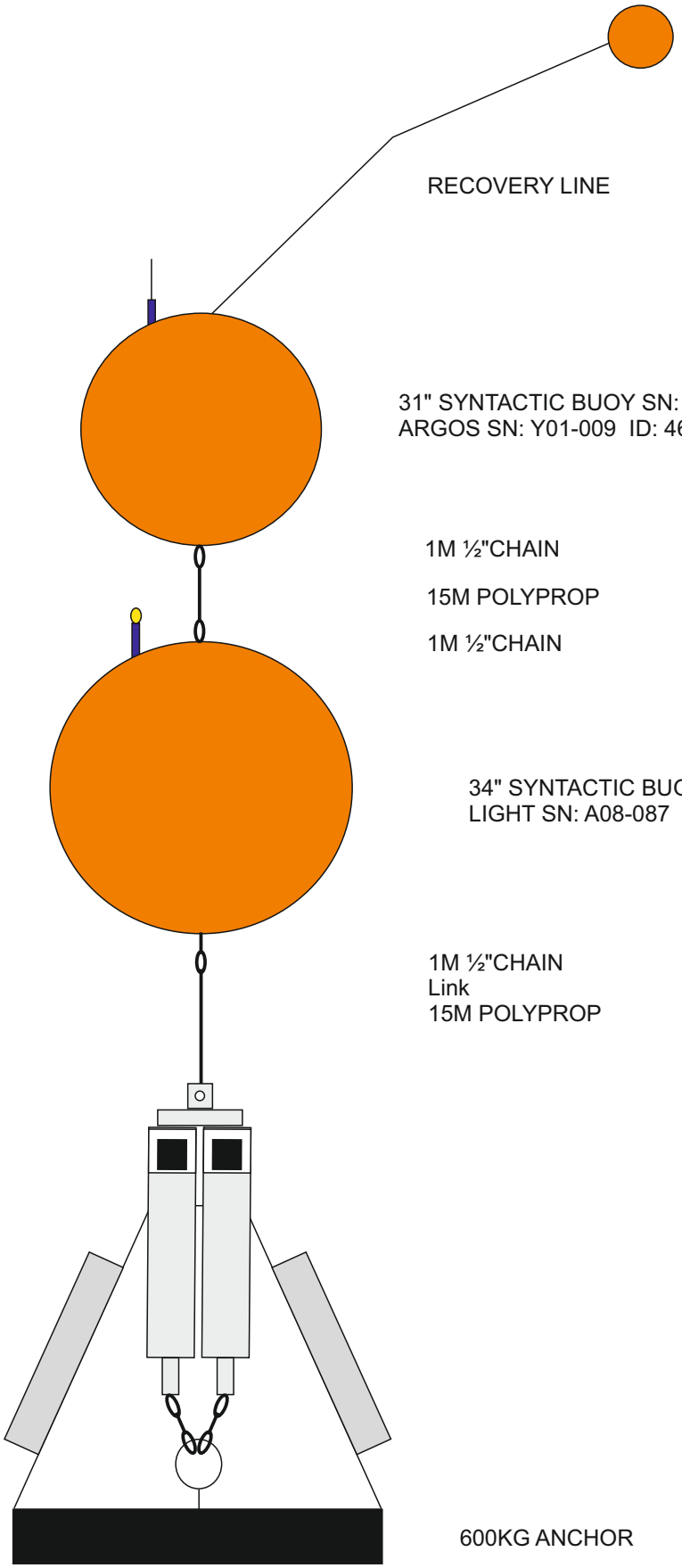


WATER DEPTH
4980M

RAPID WATCH

MAR3L11
DEPLOYED
2017

DATE: 15/03/2017
POSN: 23° 51.75'N
41° 05.89'W
DEPTH: 5029m



RECOVERY LINE

31" SYNTACTIC BUOY SN: 31-10
ARGOS SN: Y01-009 ID: 46491/3FA28BE

1M ½"CHAIN

15M POLYPROP

1M ½"CHAIN

34" SYNTACTIC BUOY SN: 34-03
LIGHT SN: A08-087

1M ½"CHAIN
Link
15M POLYPROP

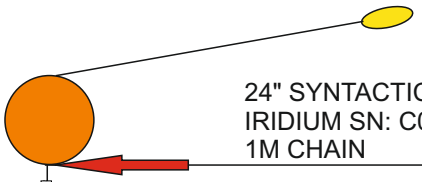
2 OFF BPR'S
SN: 53-0056
SN: 53-0426

600KG ANCHOR

RAPID WATCH

MAR 1 DEPLOYED 2017

DATE: 19/03/2017
POSN: 24° 10.00'N
49° 44.69'W
DEPTH: 5211m

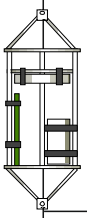


BUOY 34M

24" SYNTACTIC LIGHT SN: A08-082
IRIDIUM SN: C02-047 ID: 300234061668230
1M CHAIN

8 GLASS SPHERES
37M
SWIVEL
7.4M CHAIN
TO FRAME

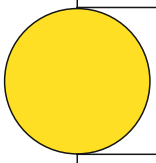
SENSOR FRAME
RAS-500
CONTROS CO2
SEAPHET
SBE ODO
SBE SMP



ML13278-01
CO2-0812-005
721-0104
14150
3890

57M 4MM WIRE

SBE 100M 3912



BUOY 109M

1M CHAIN
37" STEEL SPHERE
ARGOS SN: Y01-026 ID: 46499/3FA8E35 LIGHT SN: S01-189
1M CHAIN SWIVEL

SBE 175M 3249

SBE 250M 5765

SBE 325M 3207

667M 5MM WIRE

SBE 400M 5780

SBE ODO 400M 10518

SBE 600M 6827

9 GLASS SPHERES
780M
SWIVEL

SBE ODO 800M JOIN 14114

SBE 800M JOIN 3244

SBE 1000M 3216

704M 3/16" WIRE

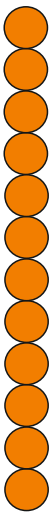
SBE 1200M 3213

RCM11 1500M JOIN 445

SBE ODO 1500M JOIN 14115

283M 3/16" WIRE

SBE 1600M 3252



12 GLASS SPHERES
1780M
SWIVEL

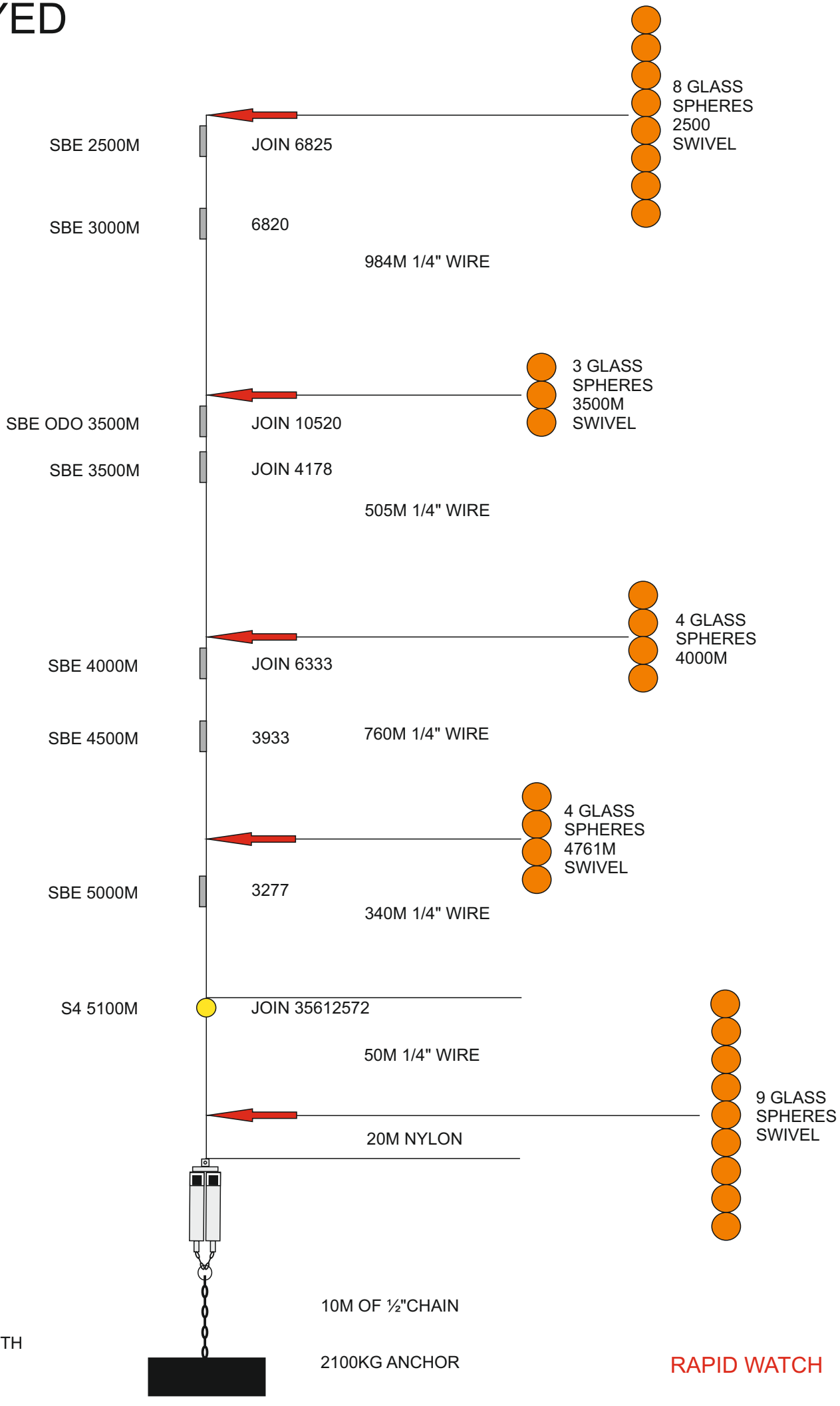
SBE 2000M 5785

700M 1/4" WIRE

SBE ODO 2000M 14148

RAPID WATCH

MAR 1 DEPLOYED 2017

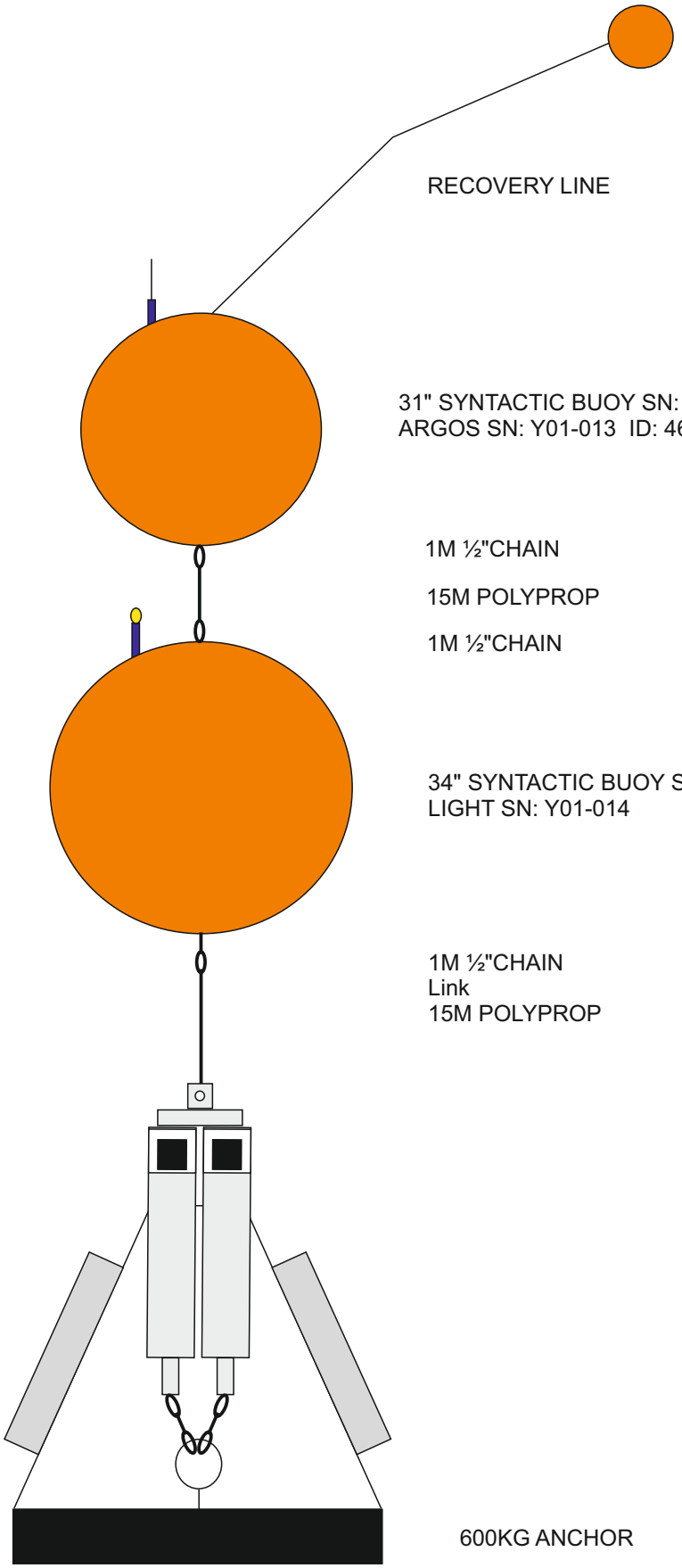


WATER DEPTH
5211M

RAPID WATCH

MAR1L11
DEPLOYED
2017

DATE: 18/03/2017
POSN: 24° 12.02'N
49° 43.95'W
DEPTH: 5221m



RECOVERY LINE

31" SYNTACTIC BUOY SN: 31-07 (J08353-002)
ARGOS SN: Y01-013 ID: 46498/3FA8E26

1M ½"CHAIN

15M POLYPROP

1M ½"CHAIN

34" SYNTACTIC BUOY SN: 34-04 (J08352-001)
LIGHT SN: Y01-014

1M ½"CHAIN
Link
15M POLYPROP

2 OFF BPR'S
SN: 53-0432
SN: 53-0034

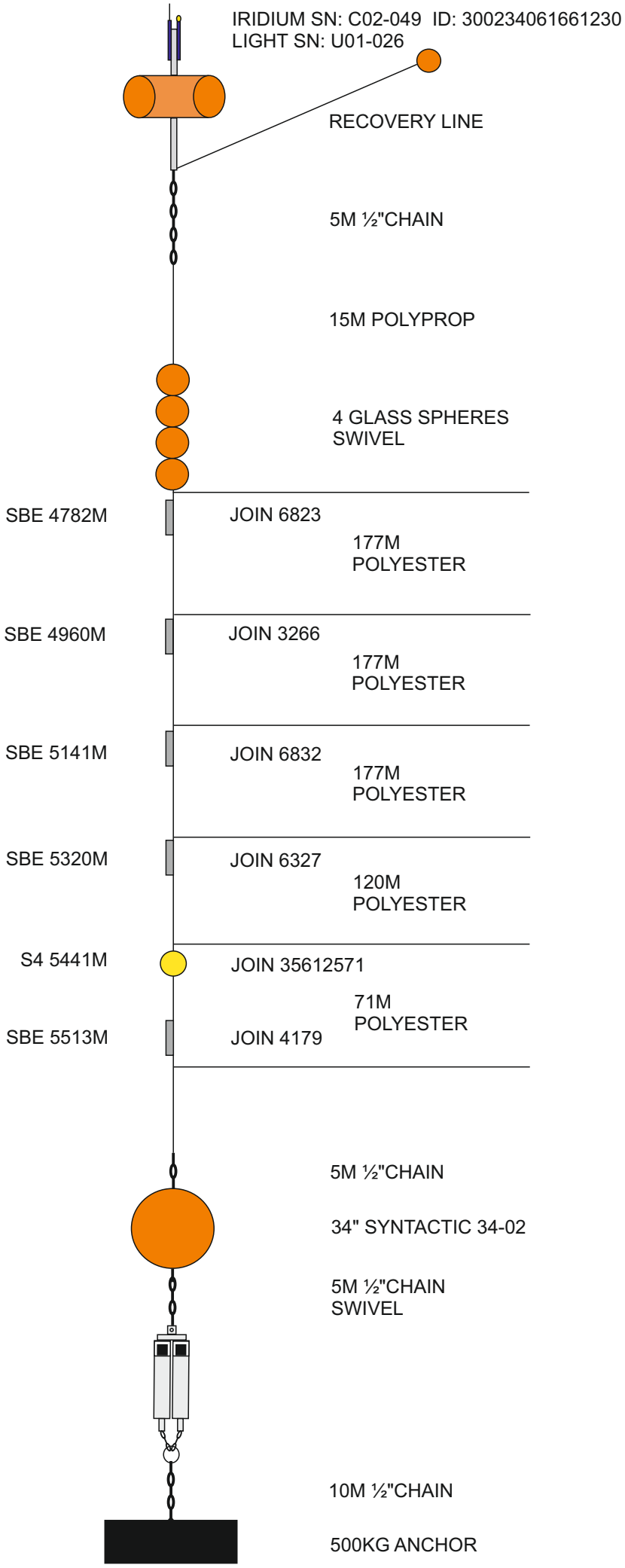
600KG ANCHOR

WATER DEPTH
5220M

RAPID WATCH

MAR0
DEPLOYED
2017

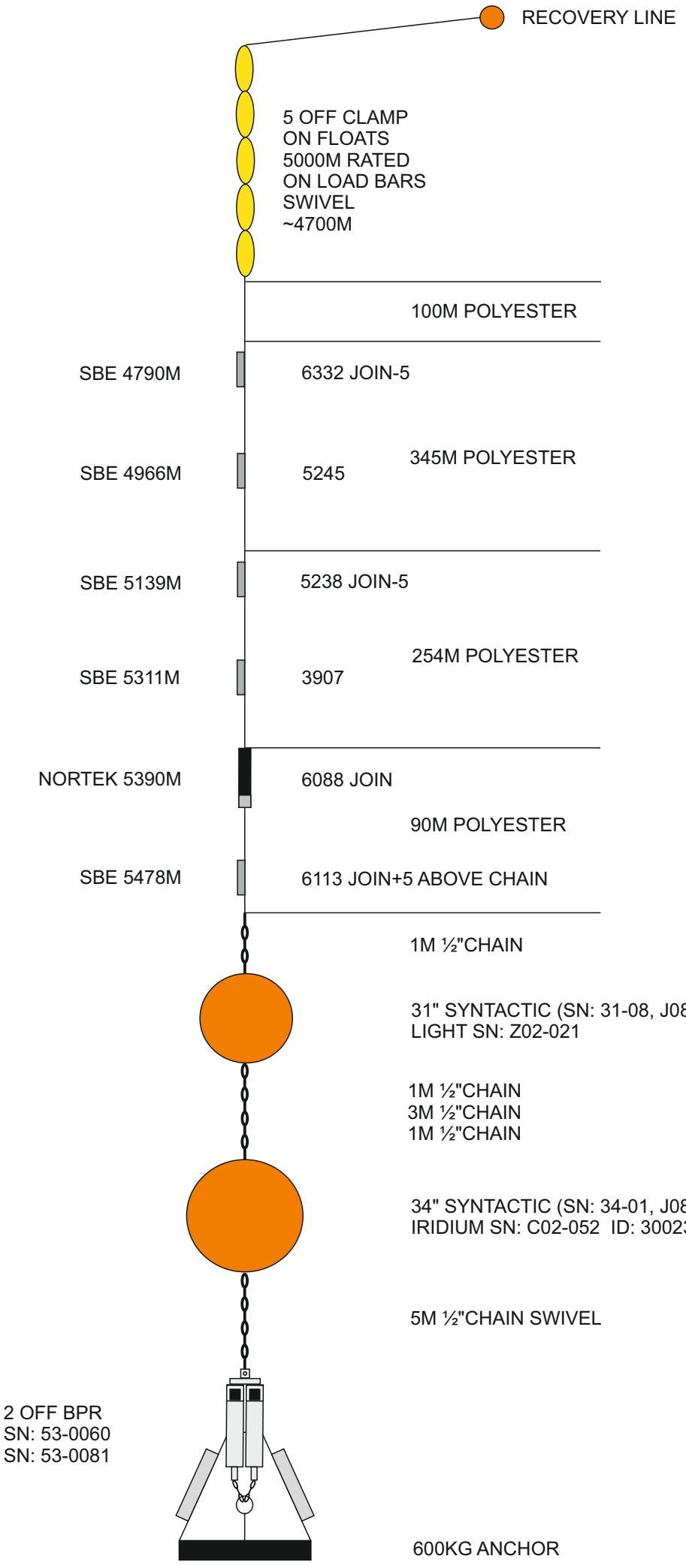
DATE: 20/03/2017
POSN: 25° 08.45'N
52° 01.31'W
DEPTH: 5540m



RAPID WATCH

WB 6
DEPLOYED
2017

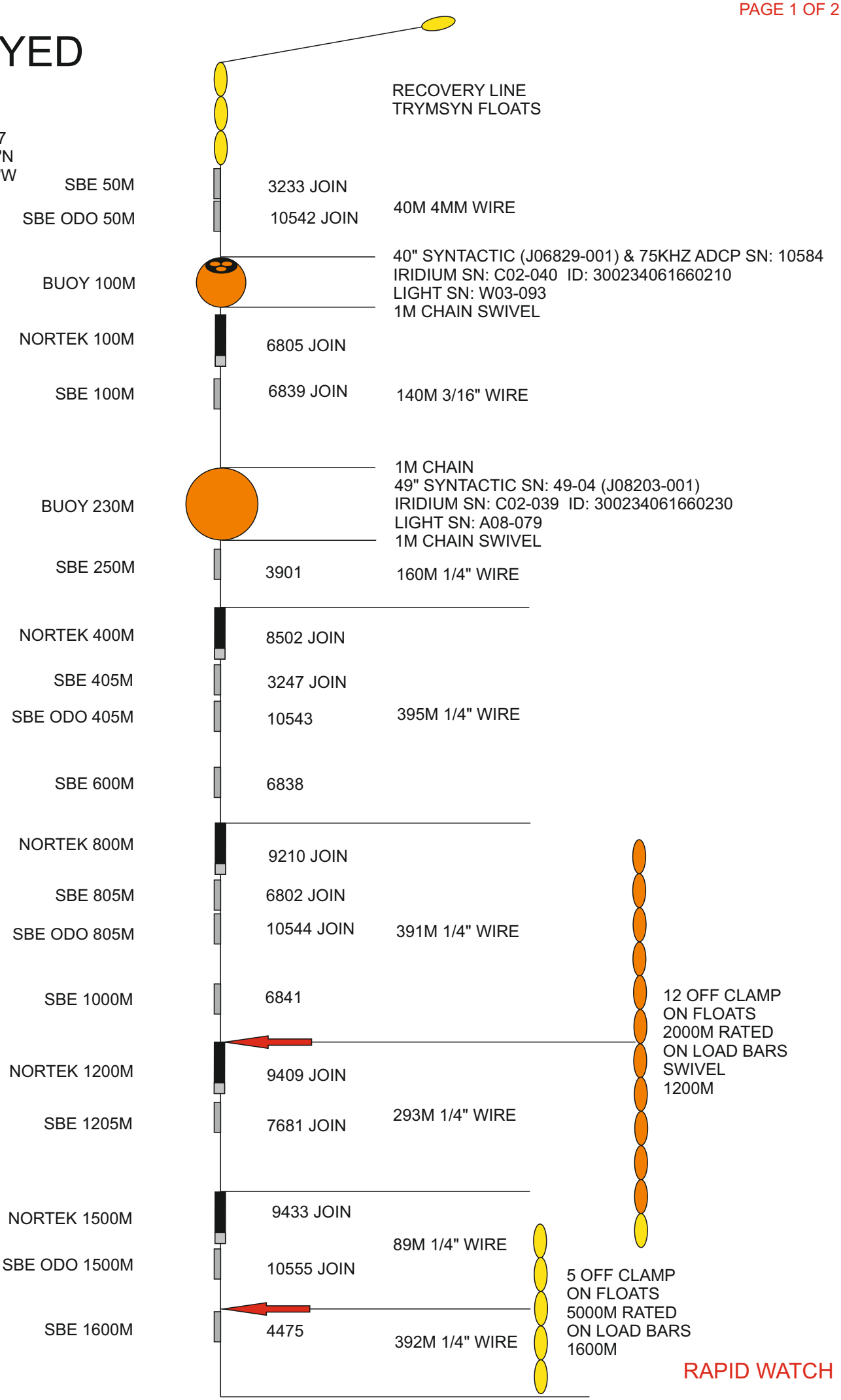
DATE: 06/04/2017
POSN: 26° 29.68'N
70° 31.40'W
DEPTH: 5493m



RAPID WATCH

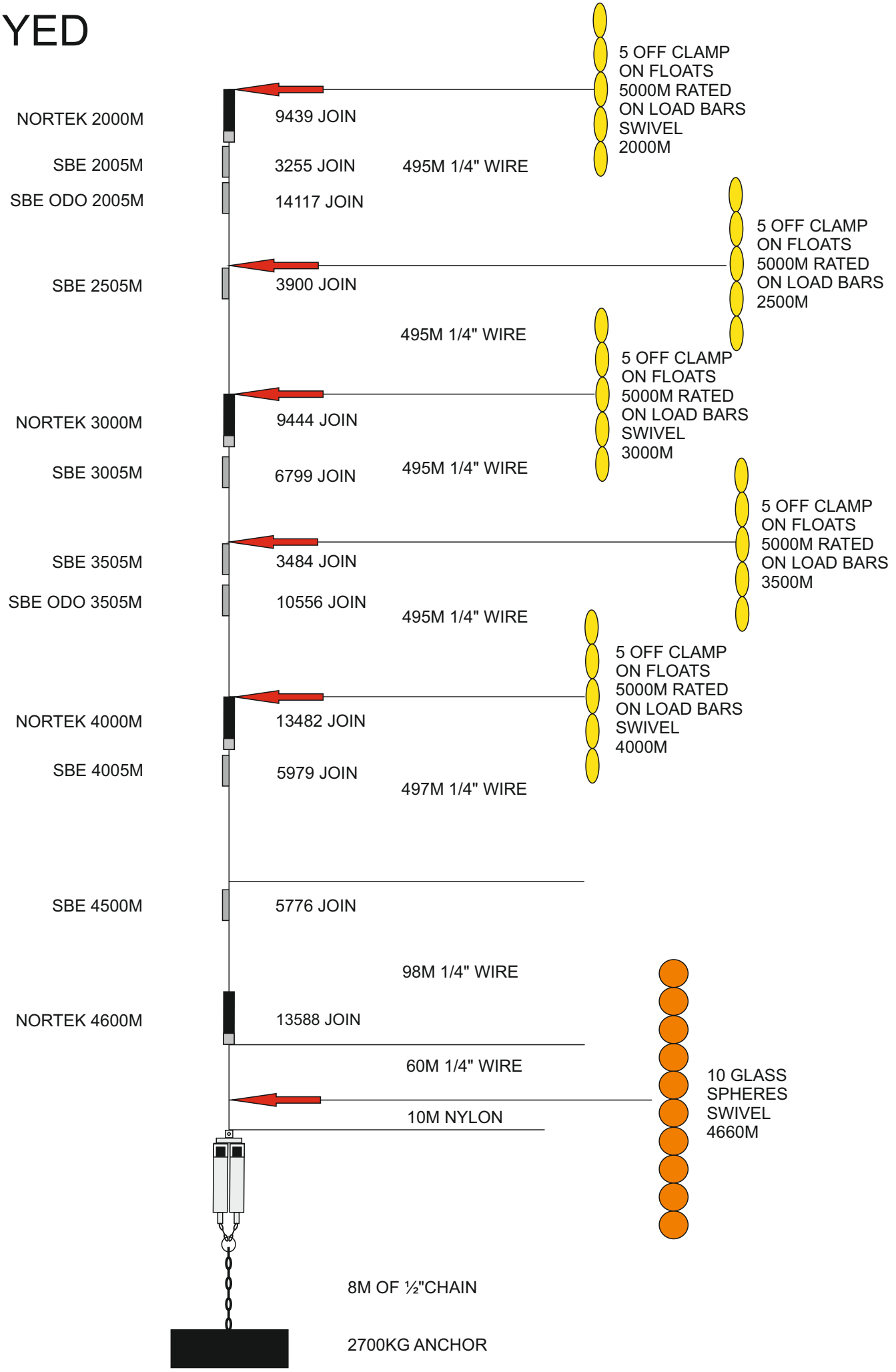
WB 4 DEPLOYED 2017

DATE: 03/04/2017
POSN: 26° 26.98'N
75° 43.22'W
DEPTH: 4683m



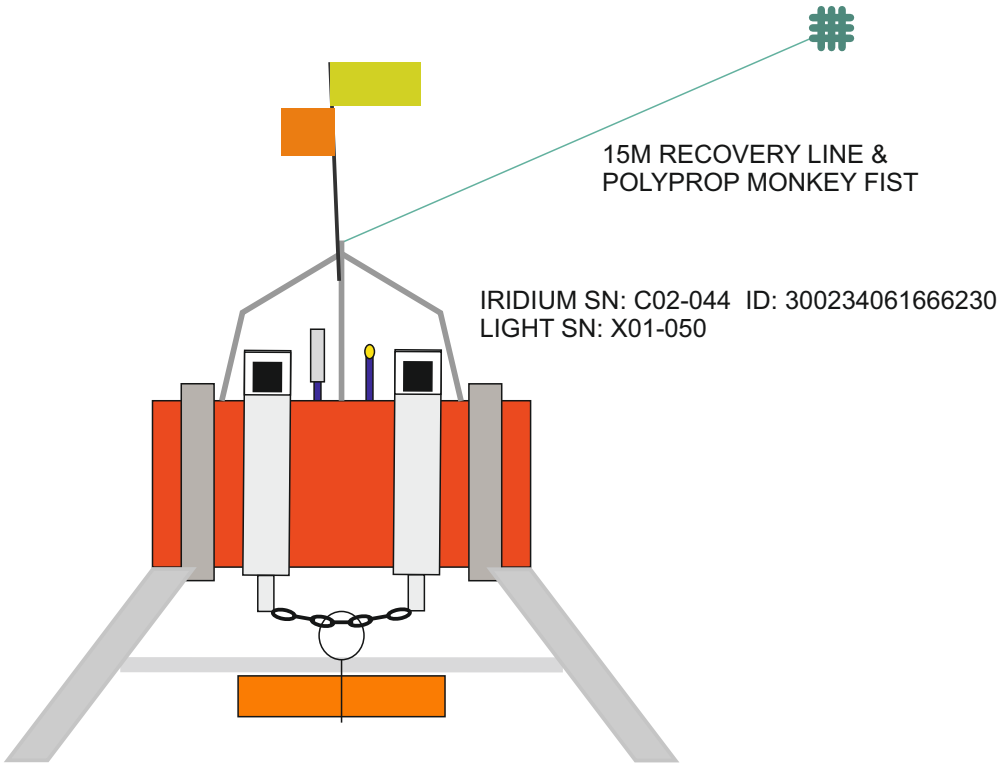
RAPID WATCH

WB 4 DEPLOYED 2017



WB4L12
DEPLOYED
2017

DATE: 02/04/2017
POSN: 26° 28.70'N
75° 42.20'W
DEPTH: 4695m



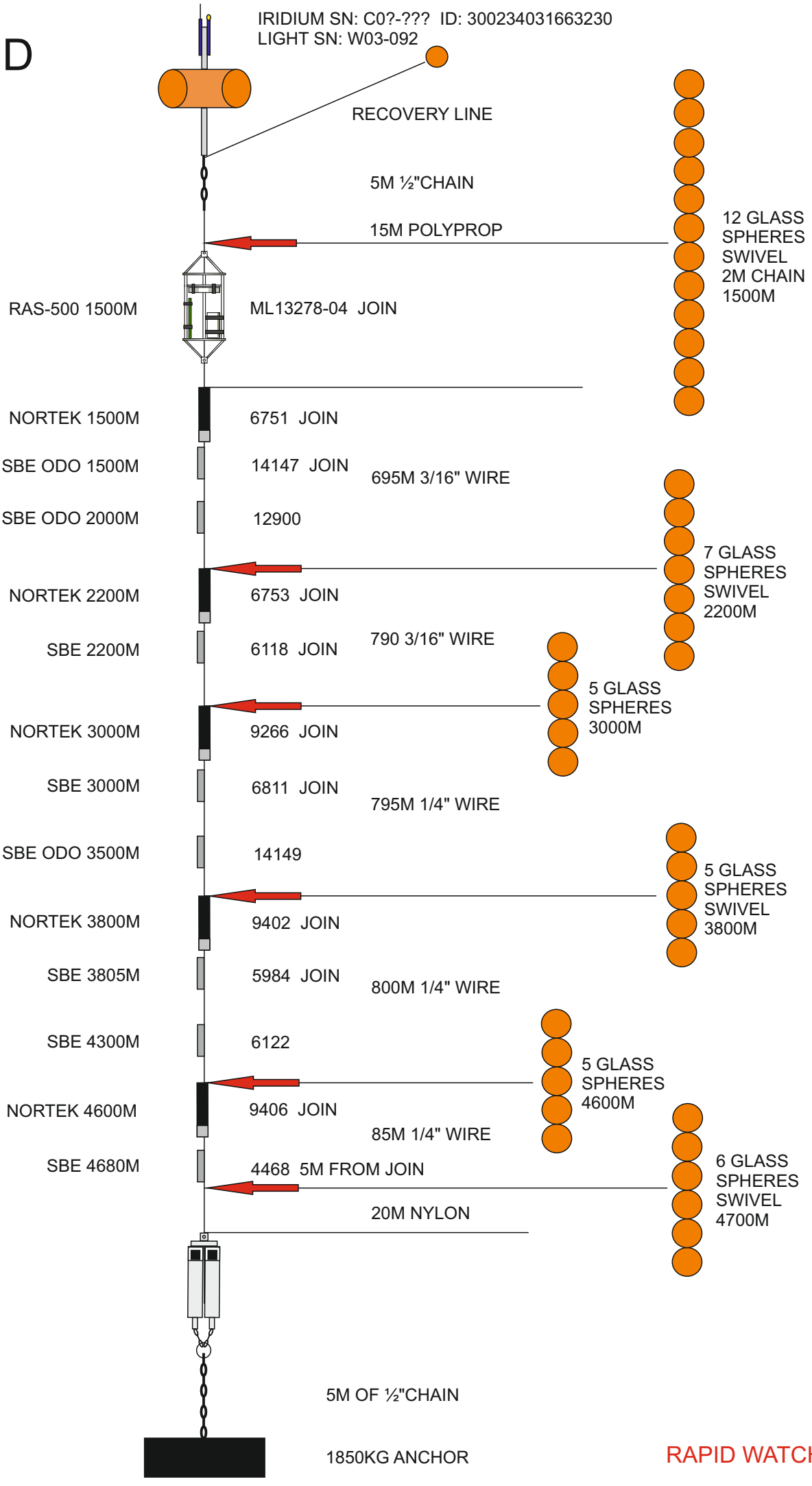
2 OFF BPR
SN: 53-0431
SN: 26-0389

DESCENT RATE = 41M/MIN
ASCENT RATE = 21M/MIN

RAPID WATCH

WBH 2 DEPLOYED 2017

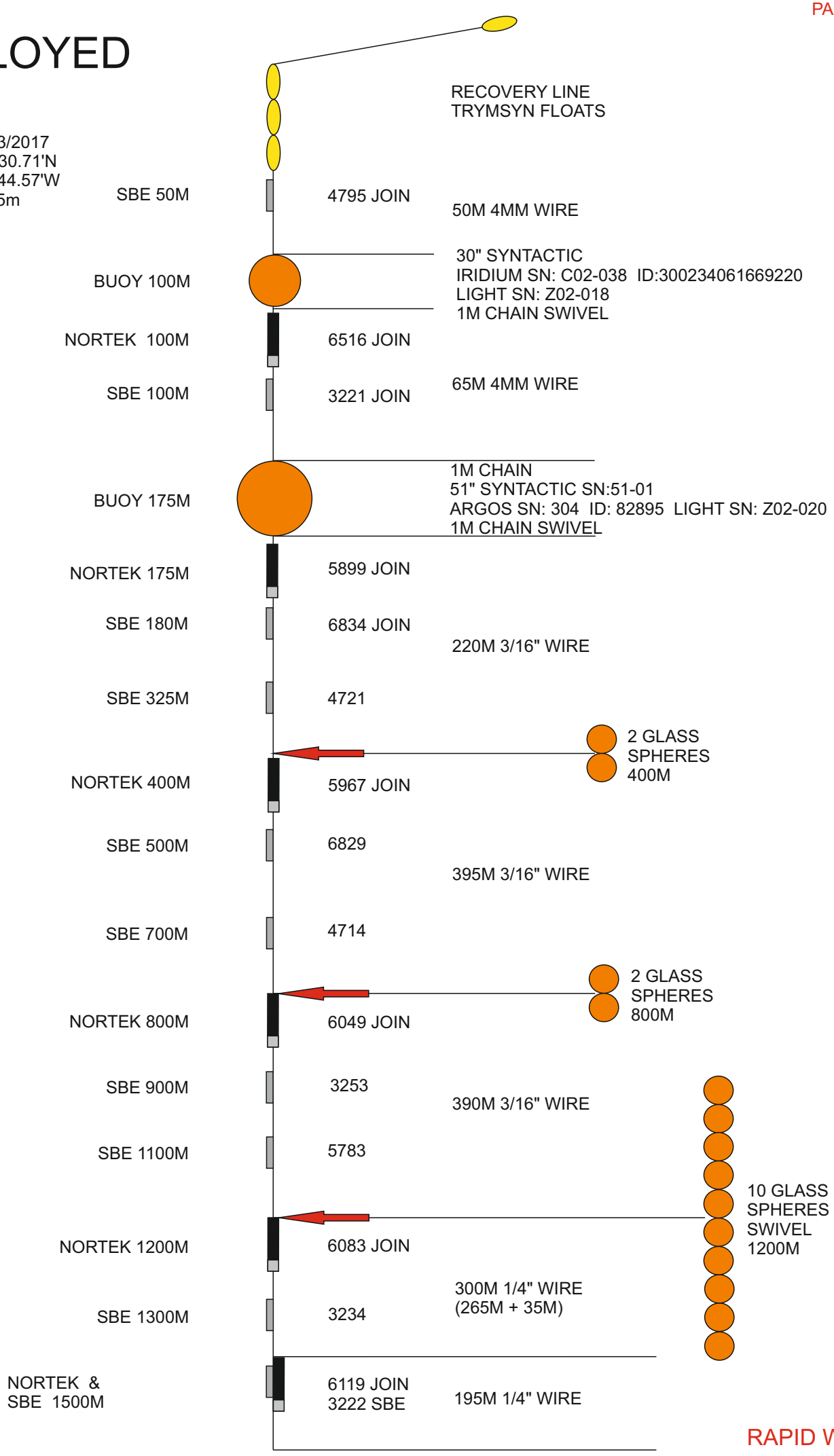
DATE: 01/04/2017
POSN: 26° 28.87'N
76° 37.58'W
DEPTH: 4729m



RAPID WATCH

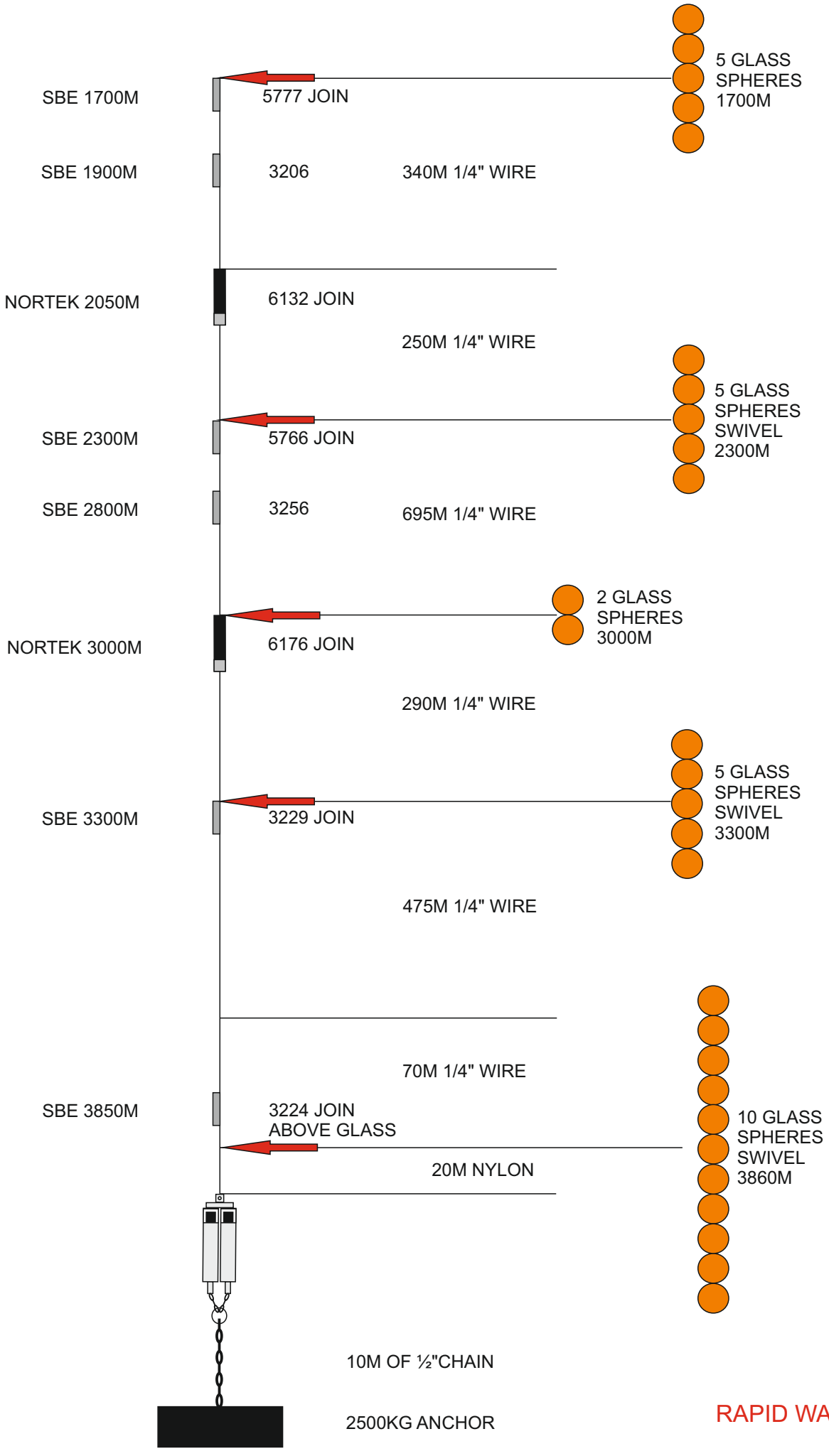
WB 2 DEPLOYED 2017

DATE: 30/03/2017
POSN: 26° 30.71'N
76° 44.57'W
DEPTH: 3895m



RAPID WATCH

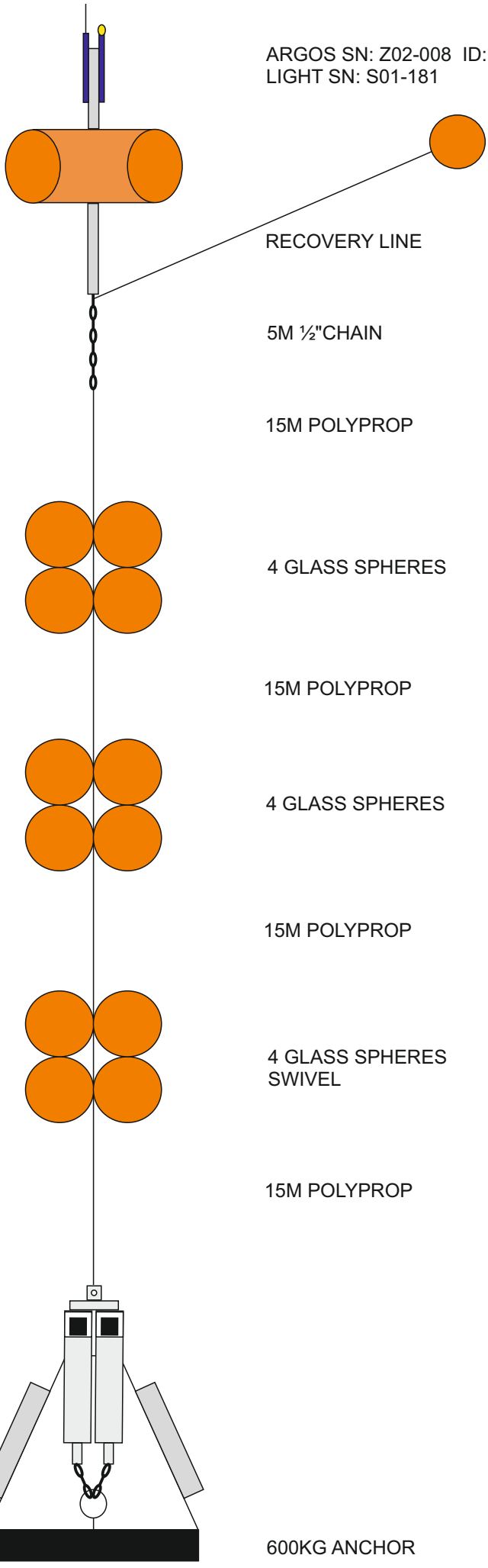
WB 2 DEPLOYED 2017



RAPID WATCH

WB2L12
DEPLOYED
2017

DATE: 29/03/2017
POSN: 26° 30.20'N
76° 44.61'W
DEPTH: 3871m



ARGOS SN: Z02-008 ID: 53157/781755F
LIGHT SN: S01-181

RECOVERY LINE

5M ½"CHAIN

15M POLYPROP

4 GLASS SPHERES

15M POLYPROP

4 GLASS SPHERES

15M POLYPROP

4 GLASS SPHERES
SWIVEL

15M POLYPROP

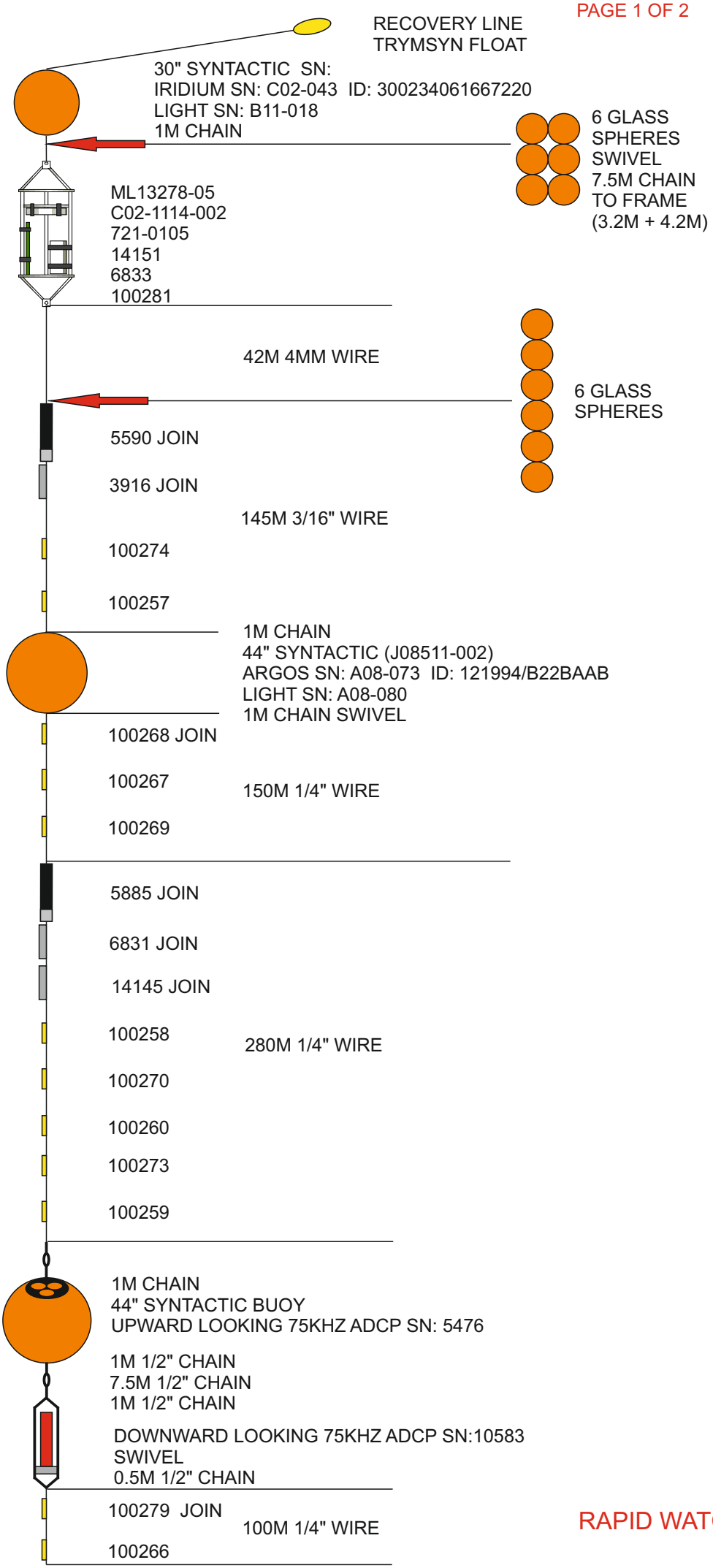
STAINLESS FRAME
2 OFF BPR
SN: 53-0057
SN: 53-0064

600KG ANCHOR

RAPID WATCH

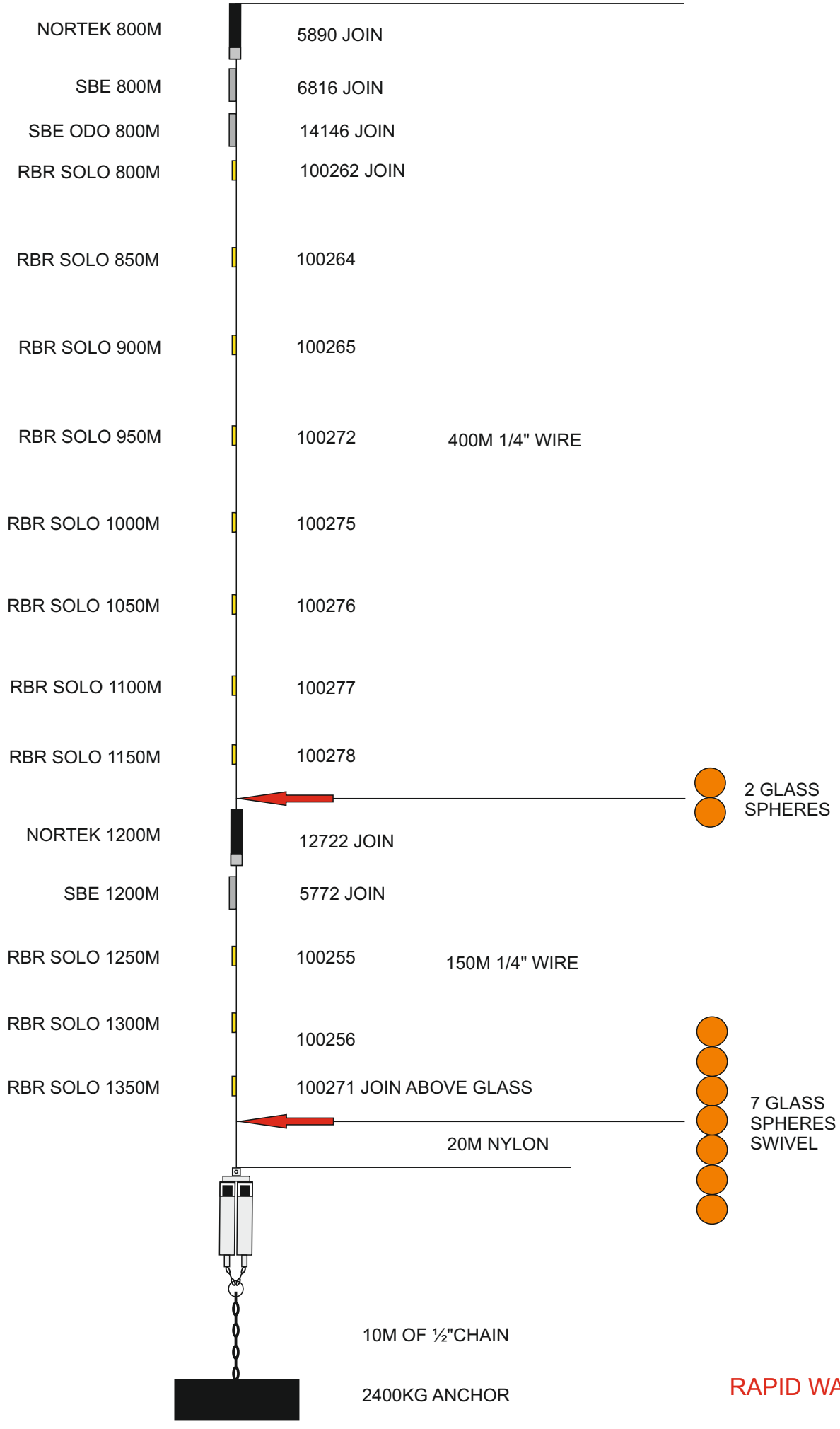
WB 1 DEPLOYED 2017

DATE: 30/03/2017
POSN: 26° 30.71'N
76° 44.57'W
DEPTH: 1391m



RAPID WATCH

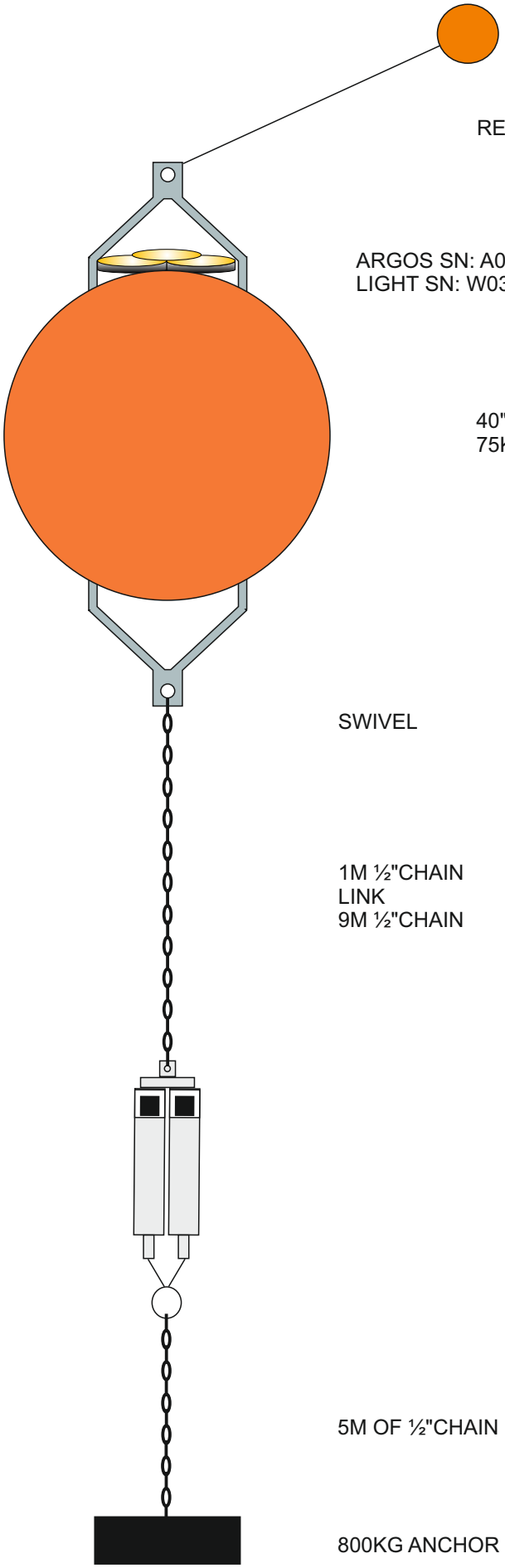
WB 1 DEPLOYED 2017



RAPID WATCH

WB ADCP DEPLOYED 2017

DATE: 28/03/2017
POSN: 26° 31.82'N
76° 52.00'W
DEPTH: 600m



RECOVERY LINE

ARGOS SN: A08-074 ID: 121995/B22BABE
LIGHT SN: W03-096

40" SYNTACTIC SN: J08433-001
75KHZ ADCP SN: 23643

SWIVEL

1M ½"CHAIN
LINK
9M ½"CHAIN

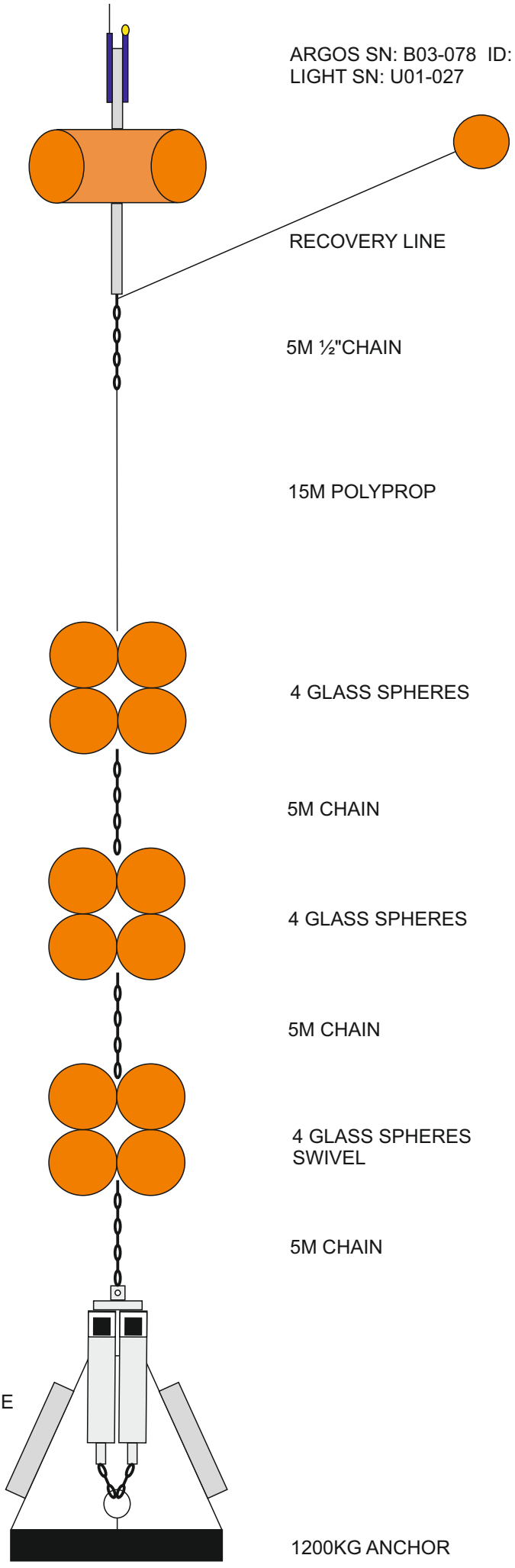
5M OF ½"CHAIN

800KG ANCHOR

RAPID WATCH

WBAL7
DEPLOYED
2017

DATE: 28/03/2017
POSN: 26° 32.24'N
76° 53.17'W
DEPTH: 612m



ARGOS SN: B03-078 ID: 129571/C023435
LIGHT SN: U01-027

RECOVERY LINE

5M ½"CHAIN

15M POLYPROP

4 GLASS SPHERES

5M CHAIN

4 GLASS SPHERES

5M CHAIN

4 GLASS SPHERES
SWIVEL

5M CHAIN

STAINLESS FRAME
2 OFF BPR
SN: 53-0428
SN: 53-0054

1200KG ANCHOR

RAPID WATCH

Appendix B: Logsheets of recovered moorings

RAPID-AMOC MOORING LOGSHEET **RECOVERY**

Mooring **EBH4** Cruise **JC145**

NB: all times recorded in GMT

Date 21/3/17 **Site arrival time** 09:45

Time of first ranging 09:45

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	SURFACED 09:57 GRAPNELLED 10:25	10:30
Billings Float	n/a	FAIRLY HEAVY FOULING	10:36
with Light	Y01-014		
and Iridium Beacon	C02-039	BEACON ID: 300234061660230	
4 x 17" glass	n/a		10:42
MicroCAT	3257 ✓		10:45
MicroCAT	3893 ✓		10:49
3 x 17" glass	n/a ✓		10:51
MicroCAT	6817 ✓		10:57
MicroCAT	6818 ✓		10:58
2 x 17" glass	n/a		10:58
MicroCAT	5766 ✓		11:00
MicroCAT	6332 ✓		11:04
2 x 17" glass	n/a		11:06
MicroCAT	5238 ✓	Tangled with glass	11:07
MicroCAT	3266 ✓		
2 x 17" glass	n/a		11:16
RCM11	516 ✓	banged on ship (tangled with glass)	11:18
MicroCAT	3212 ✓		11:19
MicroCAT	3216 ✓		11:26
6 x 17" glass	n/a	ON SURFACE ~ 10:07	11:27
Swivel	n/a		
Acoustic Release 1	2071		11:27
Acoustic Release 2	2072		11:27

Ascent Rate _____

2071
2072

Ranging

Time	Range 1	Range 2	Command/comment	
2071 09:49:50	1400	1142	PINGED SYNC ON	ARM + ARM
09:50:07	1142	1142		ARM + ARM
09:51:44	1142	1142	VCAT 8.5V	ARM + DIAG
09:53:53	1142	1142	ARM + MCL OK	
09:54:37	1096	1087		

RAPID-AMOC MOORING LOGSHEET **RECOVERY**

Mooring **EBH4L5** Cruise **JC145**

NB: all times recorded in GMT

Date 1/3/17 **Site arrival time** _____

Time of first ranging 11:53

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	ON SURFACE 12:23:50 GRAPPLED 12:32	12:34
Billings Float	n/a	TOP FLOAT TANNED ~~- pulling to bottom pack~~	12:39
with Light	W03-097 ✓	TO NEXT 2 GLASS.	
and Argos Beacon	A08-069 ✓	Beacon iD: 121990	
4 x 17" glass	n/a		12:39
4 x 17" glass	n/a		12:41
4 x 17" glass	n/a		12:42
BPR	0395 ✓		12:47
BPR	0033 ✓		12:47
Acoustic Release #1	1348 ✓		12:47
Acoustic Release #2	1533 ✓		12:47

Ascent Rate _____

Ranging

1348
1533

[redacted]

	Time	Range 1	Range 2	Command/comment
1348	11:53:03	/	1114	ARM + ARM
	11:53:32	1111	1110	
1533	11:54:30	~~10~~ /	1097	ARM + ARM
	11:55:00	1095	1094	
1348	12:12:57	1046	1047	ARM + REL OK
	12:13:32	1014	1004	
	12:14:32	927	919	N 86 m/min
				ETA 12:24

RAPID-AMOC MOORING LOGSHEET **RECOVERY**

Mooring **EBH3** Cruise **JC145**

NB: all times recorded in GMT

Date ~~2/2/17~~ 2/3/17 **Site arrival time** OVERNIGHT

Time of first ranging _____

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	SPOTTED 08:04 GRAPNELLED 08:27	08:28
Billings Float	n/a	moderate fouling, or lots	08:35
with Light	Z08-049		"
and Iridium Beacon	C02-048	Beacon ID:300234061662230	"
4x17" glass	n/a	fouled	08:36
Swivel	n/a		
MicroCAT	3890 ✓	heavily fouled.	08:41
MicroCAT	6832 ✓	fouled	08:44
MicroCAT	5765 ✓	lightly fouled	08:47
MicroCAT	6816 ✓		08:50
3x17" glass	n/a	tangled around next CAT's dummy plug.	08:53
MicroCAT	3244 ✓		"
MicroCAT	3912 ✓		08:58
5x 17" glass	n/a		09:00
Swivel	n/a		
RCM11	443 ✓		09:01
MicroCAT	6833 ✓		09:02
MicroCAT	5772 ✓		09:05
4 x 17" glass	n/a	ON SURFACE 08:11	09:08
MicroCAT	5245 ✓		09:10
RCM11	428 ✓		09:13
MicroCAT	3252 ✓		09:14
3 x 17" glass	n/a	ON SURFACE ~~08:18~~ 08:21 (LAST TO SURFACE)	09:17
MicroCAT	3213 ✓		09:20
RCM11	426 ✓		09:22
MicroCAT	3249 ✓		09:26
3 x 17" glass	n/a	~~ON SURFACE 08:18 (LAST~~ ON SURFACE 08:18	09:28
MicroCAT	3207 ✓	Tangled to glass.	"
RCM11	518 ✓		09:34
3907 — MicroCAT	~~3244~~	light fouling.	09:38
4 x 17" glass	n/a	ON SURFACE 08:18	"
Swivel	n/a		
Acoustic Release 1	824 ✓	light fouling	09:39
Acoustic Release 2	2067 ✓	" "	09:39

Ascent Rate _____

Ranging

Time	Range 1	Range 2	Command/comment
07:51:50	/	1444	ARM + ARM
07:52:20	1444	1444	
07:53:03	1444	1444	ARM + DIAG VERTICAL 8.5V
07:54:07	/	1444	ARM + DIAG VERTICAL "−12.7V"
07:54:57	1444	1444	ARM + DIAG. VERTICAL 8.3V
08:02:50	1444	1444	ARM + REL RELEASE OK
08:03:20	0	1409	
08:03:40	1389	1380	

RAPID-AMOC MOORING LOGSHEET **RECOVERY**

Mooring **EBH2** Cruise **JC145**

NB: all times recorded in GMT

Date 2/3/17 **Site arrival time** ~15:57

Time of first ranging 16:00

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	SPOTTED 16:32 ALL ON SURFACE @ 16:35	16:44
Billings Float	n/a	GRAPNELLED 16:43	"
with Light	S01-189 ✓		16:48
and Argos Beacon	Y01-013 ✓	Beacon ID: 46498 AERIAL MISSING	"
2 x 17" glass	n/a	TANGLED TOGETHER	"
Swivel	n/a		
MicroCAT	3265 ✓		
2 x 17" glass	n/a		16:58
MicroCAT	3271 ✓		"
RCM11	519 ✓		17:01
MicroCAT	3214 ✓		17:04
3 x 17" glass	n/a		17:05
Swivel	n/a		
Acoustic Release #1	2073		
Acoustic Release #2	2066		
500kg Anchor	n/a		

Ascent Rate 75 m/min

Ranging

	Time	Range 1	Range 2	Command/comment
REL #1	16:00:20	787 ×	2050	ARM + ARM
	16:00:50	2053	2053	
REL #2	16:02:00	—	2056	ARM + DIAG VERTICAL "-12.7V"
	16:02:40	2056	562 ×	VERTICAL "16.5V"
	16:03:10	2056	2056	VERTICAL 8.3V
#2	16:06:55	2056	2056	ARM + RELEASE ×
	16:07:30	2025	2014	ARM + REL ×
	16:08:30	1945	1937	
	16:09:30	1870	1862	ETA ~ 16:30

RAPID-AMOC MOORING LOGSHEET **RECOVERY**

Mooring **EBH1** Cruise **JC145**

NB: all times recorded in GMT

Date 3/3/17 **Site arrival time** ~09:10

Time of first ranging 09:08

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	GRAPNELLED 10:29	10:29
Billings Float	n/a	SURFACED 10:09	10:37
with Light	T05-078		
and Argos Beacon	C02-049	Beacon ID: 300234061601230	
2 x 17" glass	n/a		TANGLED
Swivel	n/a		
MicroCAT	3220 ✓		
2 x 17" glass	n/a	ON SURFACE 10:10	10:47
RCM11	444 ✓		10:54
MicroCAT	3251 ✓		10:57
3 x 17" glass	n/a	ON SURFACE 10:12	10:58
Swivel	n/a		
Acoustic Release #1	2074		
Acoustic Release #2	2077		
~~500kg Anchor~~			

Ascent Rate 81 m/min

Ranging

Time	Range 1	Range 2	Command/comment
09:08:04	857 x	—	ARM + ARM SN 2074
09:08:26	—	—	
09:09:00	—	3653	
09:09:31	3650	3646	
09:10:14	—	—	ARM + ARM
09:11:00	—	—	
09:11:35	3556	—	
09:12:17	—	—	
09:28:17	—	3039	ARM + RELEASE NO ANSWER
09:28:59	3011	3003	OK.
09:29:59	—	2908	
09:30:59	—	—	
09:32:11	2752	2743	
09:33:11	—	—	

STILL MOVING AT 1KT AND SEA STATE NOT GREAT

SN 2077

2074

259m IN 192 SECONDS => 81 m/min ETA ~10:00

RAPID-AMOC MOORING LOGSHEET **RECOVERY**

Mooring **EBH1L10** Cruise **JC145**

NB: all times recorded in GMT

Date ~~3/3~~ 3/3/17 **Site arrival time** OVERNIGHT

Time of first ranging 07:58

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	SPOTTED 08:41 GRAPNELLED 08:49	08:53
Billings Float	n/a	BUT TANGLED UP	08:54
with Light	A1556		
and Argos Beacon	AZ02-0080	Beacon ID: 53157	
4 x 17" glass	n/a		08:53
4 x 17" glass	n/a		08:54
4 x 17" glass	n/a		08:55
BPR	0414		08:59
BPR	0030		↓
Acoustic Release #1	925		
Acoustic Release #2	262		

Ascent Rate 77 m/min

Ranging

	Time	Range 1	Range 2	Command/comment
262	07:58:38	/	/	ARM + ARM
	07:59:05	/	/	
925	08:00:10	/	4562	ARM + ARM
	08:01:00	3044	3044	
	08:01:14	3044	3045	
262	08:01:55	/		
	08:03:05	3044	3044	ARM + REL OK.
	08:03:34	3020	3013	ARM + REL OK.
	08:04:34	2942	2934	
	08:05:34	2866	2858	
				ETA 08:42

RAPID-AMOC MOORING LOGSHEET **RECOVERY**

Mooring **EBHi** Cruise **JC145**

NB: all times recorded in GMT

Date 5/3/17 **Site arrival time** OVERNIGHT

Time of first ranging 08:50

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	ON SURFACE 09:30 HOOKED 10:03	10:04
49" telemetry buoy	n/a		10:10
with Light	W03-089	Tangled	10:10
and Iridium Beacon	C02-047	Beacon ID:30023406168230	"
MicroCAT	7470		"
2 x 17" clamp-on glass	n/a	SURFACED 09:39 Tangled with CAT	10:29
MicroCAT	~~5486~~ 7362		"
2 x 17" clamp-on glass	n/a	SURFACED 09:40 previous glass	10:43
Nortek	~~4719~~ 12700	Tangled with ~~MicroCAT~~	10:43
MicroCAT	~~449~~ 4799		10:51
4 x 17" glass	n/a	09:41 ALL ON SURFACE	10:52
Swivel	n/a		"
Acoustic Release #1	~~821~~ 361	~~1683~~ [redacted]	"
Acoustic Release #2	1~~385~~ 320	~~0756~~	"

Ascent Rate 113m/MIN.

Ranging

Time	Range 1	Range 2	Command/comment
~~#321 08:50:35~~	~~/~~		~~ARM + ARM~~
#361 08:52:20	/	4515	ARM + ARM
08:52:50	4512	4514	
#320 08:54:00	/	/	ARM + DIAG
08:54:40	/	/	
#361 08:55:30	/	4515	ARM + DIAG NO DIAGNOSTICS
08:56:30	/	4515	-11- NO DIAGNOSTICS
#364 08:59:52	4514	4515	ARM + REL OK
09:00:50	/	/	ARM + ARM
09:01:28	/	/	
#320 09:02:20	/	/	
#361 09:03:40	/	/	ARM + REL
09:04:37	3998	/	
09:05:35	/	/	
09:07:20	/	11111·8	
09:08:25	/	/	

#320	09:09:24	—	—	ARM + ARM
	09:10:25	—	—	
	09:11:40	—	—	
#361	09:13:02	3043	—	ARM + ARM
	09:14:02	2930	2920	
	09:15:02	2814	2803	

ETA: 09:31

SPOTTER: 09:30

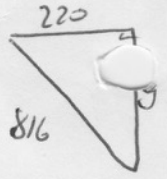
EBMiM (MYARK RECOVERY) JC145.

4/3/17

Release	Time	Range	Comment
1	20:57		TRYING MULTIPLE ENABLE COMMANDS FOLLOWED
		9868	BY RANGING WHILE ON CTD STATION
		3291	
	20:53:30	5252	MAX GAIN = NOISE
		2696	
			GAIN 9 = NOTHING
2			NOTHING
			ALL OF THE ABOVE USING HULL XDCER
1	21:30	3652	
		5658	
2		4677	RANDOM NOISE
		4229	
		1814	
2	11:37:00	4467	RANGE ONLY GAIN = 6
	11:38:20	4467	
2	11:39 ish		RELEASE ? A 4 PING HEARD
1	11:43:50		RANGE ONLY.
1			ENABLE
1	11:42:30		RANGE ONLY GAIN UPTO 8 STILL NOTHING.
	11:42:50		
	11:43:15		
	44:50		ENABLE + RANGE
2	11:46:20	4485	RANGE
1	11:49:10		RANGE
	11:50:15	6678	ENABLE
	11:51:20		
	:40		
2	11:52:20	4503	RANGE
	11:52:40	4504	
	53:35	4511	
	54:15	4514	
	11:54:44		B, C, D, E, F, G, H. ALL 1 PING REPLIES
	11:58:37	4531	
			A.
	12:00:20	4525	RANGE MULTI-PING REPLY
	12:00:45	4515	—11—
	12:01:45	4501	—11—
			ALL RANGES WHILST DRIFTING AWAY FROM SITE
			WITH ALL THRUSTERS OFF.
	12:02:45	4487	

FIG 2	12:23:55	3990	RANGE
	12:24:55	3972	
	12:25:55	3950	
	12:26:55	3928	~ 22 m/min
	12:27:55	3905	
2	15:04:50	913	
	15:05:20	903	ECHOSOUNDING STILL ON
	15:05:50	896	
	15:06:20	535	
	15:06:30	418	NOISY
	15:08:30	851	RANGE BUT 5 PING RESPONSE
	15:09:30	835	5 PING RESPONSE EVERY TIME
	15:10:30	816	
	15:12:30	787	
	15:17:42	708	=> 670m DEEP AT 227m OFF
	15:18:42	693	=> 654m DEEP AT 227m OFF
	15:24:00	608	
	15:25:00	595	=> 580m DEEP AT 226m OFF
	15:26:00	580	=> 534m DEEP AT 226m OFF
	15:36:05	454	
	15:37:20	440	
	15:38:30	427	
	15:40:30	406	
	15:44:30	368	
	45:40	361	
	47:10	358	
	49:10	361	
	49:40	365	
	RADIO BEACON HEARD AND FLARE SPOTTED 14:56		
	ALL ONBOARD BY 15:20 WITH RECOVERY LINE RUNNING		
	BROKEN AND		

24° 55.88
21° 16.03



~~y = 816~~

$816^2 = 220^2 + y^2$

$y = \sqrt{816^2 - 220^2}$

$y = 785$

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **EB1** Cruise JC145

NB: all times recorded in GMT

Date 7/3/17 **Site arrival time** OVERNIGHT

Time of first ranging 08:57

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	GRAPNELLED 09:48. FLOATING LINE HELD DOWN BY WEIGHT OF FOULING	09:49
24" syntactic	n/a	SITTING OUT OF WATER NICELY.	09:57
With light	X01-048	Barnacles on line	"
And Iridium beacon	C02-038	ID 300234061669220	10:01 - 5x glass
RAS-500 frame	13278-05	~~light~~ fouling	10:04
With Contros CO2	1114-001	HEAVY	"
And SeaFET	004 ✓		"
And MicroCAT ODO	12906 ✓		"
And MicroCAT	6827 ✓		"
MicroCAT	11744 ✓		10:07
37" steel sphere	n/a		10:11
with light	S01-182		"
and Argos Beacon	B03-077	Beacon ID: 129570	"
MicroCAT	6831 ✓		10:12
MicroCAT	6823 ✓		10:14
MicroCAT	6841 ✓		10:17
MicroCAT	6839 ✓		10:19
MicroCAT - ODO	12832 ✓		10:19
4 x 17" glass	n/a	SURFACED 09:12	10:22
MicroCAT	7681 ✓		10:29
4 x 17" glass	n/a	Tangled with next 2 CATs	10:34
MicroCAT	6112 ✓		"
MicroCAT-ODO	12833 ✓		"
MicroCAT	3916 ✓		10:43
4 x 17" glass	n/a	SURFACED 09:26	10:46
MicroCAT	6122 ✓		10:50
RCM11	451 ✓	5 MICROCAT WAS FIRST.	10:58
MicroCAT	12834 ✓		10:58
4 x 17" glass	n/a		11:00
MicroCAT	3206 ✓		11:04
MicroCAT	6113 ✓		11:15
MicroCAT-ODO	12835 ✓		11:15
5 x 17" glass	n/a		11:23
MicroCAT	3215 ✓		11:32
MicroCAT	3256 ✓		11:45
5 x 17" glass	n/a		11:53

spool change

MicroCAT	5777 ✓		12:10
MicroCAT-ODO	12900 ✓		"
4 x 17" glass	n/a		12:21
MicroCAT	3224 ✓		12:25
4 x 17" glass	n/a		12:38
MicroCAT	3253 ✓		12:40
RCM11	450 ✓		12:53
MicroCAT	3222 ✓		12:55
8 x 17" glass	n/a	3 implosions	12:57
Swivel	n/a		"
Acoustic Release #1	825		13:00
Acoustic Release #2	1534		"

Ascent Rate _____

Ranging

Time	Range 1	Range 2	Command/comment
08:57:15	✓	✓	SN 825 ARM + MM
08:58:00	✓	✓	
08:58:45	✓	✓	
08:59:50	✓	✓	SN 1534 ARM + ARM
09:00:55	✓	5112	
09:01:30	✓	✓	
09:02:30	✓	✓	
09:05:30	✓	✓	SN 1534 ARM + REL ~800m AWAY FROM SITE
09:06:20	✓	✓	
09:06:59	✓	✓	
09:07:40	✓	✓	
			~~SN 825~~ SPOTTED ON SURFACE BY ORIOLE 09:08

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **EB1L10** Cruise **JC145**

NB: all times recorded in GMT

Date 6/3/17 **Site arrival time** OVERNIGHT

Time of first ranging 08:19

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	SURFACED 09:34	
31" syntactic	n/a	PICKUP LINE NOT VISIBLE	09:52
and Argos Beacon	A08-073	Beacon ID: 121984	
34" syntactic	n/a	LIGHT SMASHED	09:52
Lander tripod		FRAME IN GOOD CONDITION (PAINTED STEEL)	09:57
With BPR #1	391 ✓		
And BPR #2	0038 ✓		
And Acoustic Release #1	264		
And Acoustic Release #2	921		

Ascent Rate _____

Ranging

	Time	Range 1	Range 2	Command/comment
264	08:19:17	—	—	ARM + ARM
	08:[illegible]:58	—	—	
	08:20:37	—	5048	
	08:21:10	—	—	
921	08:22:10	—	—	
	08:22:50	—	—	
	08:23:35	—	—	
	08:24:25	—	—	
264	08:30:32	5048	—	ARM + ARM
	08:31:44	—	—	ARM + RELEASE
	08:32:51	—	—	ARM + REL
	33:31	—	—	
921	34:27	4856 — 77 m/min	4846	ARM + ARM
	35:27	4779	4766 — 80 m/min	
	36:27	—	4676	
	37:27	—	—	
	38:27	4540	4530	316 m IN 4 MINS
				ETA ~ 09:35

TRICKY UNTANGLING AS LINES TANGLED

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **NOG** Cruise **JC145**

NB: all times recorded in GMT

Date 14/3/17 **Site arrival time** 09:30

Time of first ranging 09:51

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	SURFACED 10:38 GRAPPLED 11:02	
Billings Float	n/a		11:08
with Light	W03-094 ✓		↓
12 x 17" glass	n/a		
Swivel	n/a		
Sediment Trap	11804-05 ✓		11:15
Nortek	6765 ✓		"
Sediment Trap	11262-02 ✓		11:21
Nortek	9956 ✓		"
10 x 17" glass	n/a	SURFACED 10:37 Cable wrapped around itself for ~10 m.	11:50
MicroCAT	13243 ✓		12:01
Acoustic Release #1	906 ✓	[redacted]	|
Acoustic Release #2	1535 ✓		

Ascent Rate 90 m/min

Ranging

	Time	Range 1	Range 2	Command/comment
1535	09:51:45	/	/	ARM + ARM
	09:52:22	4238	4238	
906	09:53:20	/	/	ARM + DIAG
	09:54:03	/	8061	— " —
1535	09:55:06	4242	4238	ARM + RELEASE NOT CONFIRMED
	09:55:45	4198	4187	
	09:56:45	/	4079	
	09:57:45	4009	3998	
	10:00:45	3716	3705	

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **MAR3** Cruise **JC145**

NB: all times recorded in GMT

Date 15/3/17 **Site arrival time** OVERNIGHT

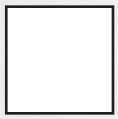
Time of first ranging _____

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	NO RECOVERY LINE	
3 x Mini-Trimsyn	n/a		~~10~~ 11:08
MicroCAT	3281 ✓	HOOKED 10:56	10:56
24" syntactic float	n/a		11:13
with Light	Y01-018		"
and Iridium Beacon	C02-051 ✓	Beacon ID: 300234061663230 ✓	"
Swivel	n/a		"
MicroCAT	3904 ✓	ID sticker lost - No data, battery?	11:16
37" Steel Sphere	n/a		11:18
with Light	Z02-023 ✓		"
and Argos Beacon	094 ✓	Beacon ID: 24027 ✓	"
Swivel	n/a		"
MicroCAT	11424 ✓	Well fouled	11:21
MicroCAT	3905 ✓	ID sticker lost	11:23
MicroCAT	3233 ✓		11:26
MicroCAT	6810 ✓		11:28
MicroCAT	4721 ✓		11:34
10 x 17" glass	n/a		11:39
Swivel	n/a		"
MicroCAT	3228 ✓		11:43
MicroCAT	6834 ✓		11:49
MicroCAT	3221 ✓		11:55
RCM11	507 ✓		12:03
MicroCAT	4795 ✓		12:07
9 x 17" glass	n/a		12.13
Swivel	n/a		"
MicroCAT	3255 ✓		12:21
4 x 17" glass	n/a		12:38
Swivel	n/a		"
MicroCAT	4475 ✓		12:~~45~~46 (?)
4 x 17" glass	n/a		12:57
Swivel	n/a		"
MicroCAT	5984 ✓		13:11
4 x 17" glass	n/a		13:23
Swivel	n/a		"
MicroCAT	5776 ✓		13:26

4 x 17" glass	n/a		13:40
Swivel	n/a		↓
MicroCAT	5979 ✓		13:42
MicroCAT	6118 ✓		13:56
4 x 17" glass	n/a ✓		14:02
MicroCAT	3484 ✓		14:10
SA S4	35612565 ✓		14:12
7 x 17" glass	n/a	6 imploded	"
Swivel	n/a		"
Acoustic Release 1	1351 ✓		14:18
Acoustic Release 2	251 ✓		"

Ascent Rate _____

1351
251



Ranging

	Time	Range 1	Range 2	Command/comment
#251	09:57:05	/	/	ARM + ARM
	57:57	/	/	
	10:02:23	5059	5059	
	10:03:40	/	5059	ARM + RELEASE REL OK
	10:04:25	/	/	
	10:05:10	/	/	
#1351	10:06:03	/	/	ARM + ARM
	10:06:45	/	/	
	10:07:30	/	/	
#251	10:08:37	/	4686	ARM + REL

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **MAR3L9** Cruise **JC145**

NB: all times recorded in GMT

Date 14/3/17 **Site arrival time** 16:42

Time of first ranging 16:30

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	17:47 NO SEE AFTER GLASS HOOKED 18:04 AS TANGLED.	18:~~28~~ 23
Billings Float	n/a		18:08
with Light	W03-083		"
and Argos Beacon	Y01-026	Beacon ID: 46499	"
4 x 17" glass	n/a	SURFACED 17:46	"
4 x 17" glass	n/a		"
4 x 17" glass	n/a		18:22
BPR	0057		18:28
BPR	0064		"
Acoustic Release #1	1383		"
Acoustic Release #2	323		"

Ascent Rate 75 m/min

Ranging

	Time	Range 1	Range 2	Command/comment
1383	16:25:45	/	/	@ 5 KTS 1.5 MILES AWAY
	16:30:35	/	5254	ARM + ARM
	16:31:07	/	9264	
323	16:32:00	5128	3667	ARM + ARM
	16:32:30	5292	1789	
	16:40:17	/	9469	
	16:40:55	5897	6488	
	16:41:40	5000	5000	@ 2.5 KTS.
	16:42:07	5000	5000	
	16:46:25	5004	/	ARM + REL NOT CONFIRMED
	16:47:05	/	/	
	16:47:50	/	/	
1383	16:49:10	/	/	ARM + ARM
	16:49:50	/	/	
323	16:50:45	4689	4680	ARM + REL OK.
	16:51:45	/	4595	
	16:52:45	4539	4528	

75 m/min ETA ~ 17:50

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **MAR1** Cruise **JC145**

NB: all times recorded in GMT

Date 18/03/2017 **Site arrival time** OVERNIGHT

Time of first ranging ~~18/03/20~~ 09:59

ITEM	SER NO	COMMENT	TIME
Mini-Trimsyn	n/a		
24.5" syntactic float			
with Light			
Argos or Iridium Beacon			
8 x 17" glass	n/a		
RAS-500	13278-03		
Contros pCO2	CO2-0412-020		
SeaFET	002		
MC-SMP-ODO	12905		
SBE37 MICROCAT	7723		
SBE37 MICROCAT	6116		
37'' McLa. SS			
with Light			
Argos or Iridium Beacon			
SBE37 MICROCAT	3269 ✓	Extensive tangled in cable + fishing line.	13:28
SBE37 MICROCAT	6802 ✓		13:38
SBE37 MICROCAT	5789 ✓	tangled	13:52
MC-SMP-ODO	12901 ✓	"	13:51
SBE37 MICROCAT	4719 ✓	"	13:51
SBE37 MICROCAT	6838		13:39
9 x 17" glass	n/a		14:13
MC-SMP-ODO	12902 ✓		14:08
SBE37 MICROCAT	3901 ✓		~~13:28~~ 14:07
SBE37 MICROCAT	5783 ✓		13:15
SBE37 MICROCAT	3229 ✓	Slight bend in connector due to wire getting trapped	13:09
RCM-11	515 ✓		12:46
MC-SMP-ODO	12907 ✓		12:46
SBE37 MICROCAT	3234 ✓		12:41
12 x 17" glass	n/a	1st hooked 12:12, 2nd 12:18	12:27
MC-SMP-ODO	12908 ✓		12:43
SBE37 MICROCAT	4714 ✓		12:43
8 x 17" glass	n/a		12:58
SBE37 MICROCAT	6836 ✓		14:18
SBE37 MICROCAT	6829 ✓		14:32
3 x 17" glass	n/a ✓		14:45
MC-SMP-ODO	12910 ✓		14:47

→ cleat off big yellow cable w/ bottle after twist

black ↑ white ↓ START

SBE37 MICROCAT	3932 ✓		14:48
4 x 17" glass	n/a		15:02
SBE37 MICROCAT	6811 ✓		15:04
SBE37 MICROCAT	6799 ✓		15:28
4 x 17" glass	n/a		15:35
SBE37 MICROCAT	3900 ✓		15:43
S4	35612576 ✓		15:46
9 x 17" glass	n/a	top 4 imploded 4 IMPLODED	15:49
Acoustic Release #1	1202		15:52
Acoustic Release #2	930		15:52

Ascent Rate _____

Ranging

Time	Range 1	Range 2	Command/comment
1202 09:59:24	1421	5186	ARM + ARM
10:00:00	5185	5186	
930 10:01:42	/	5186	ARM + RELEASE OK.
10:02:28	5152	5141	
			GLASS SPOTTED 10:20
			2ND SET SPOTTED 10:26
			3RD SET SPOTTED 10:55
10 13 00	4371	4362	
10 15 00	—	4212	
10 51 30	—	2198	
10 54 30	2091	2089	
11 30 00	839		
11 31 00	814		
11 39 45	640		
11 50 30	520		510m TO RELEASE ~ 11:48
11 55 30	525		
12 03 00	424		
12 18 30	337		
12 55 00	1224		

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **MAR1L9** Cruise **JC145**

NB: all times recorded in GMT

Date 17/3/17 **Site arrival time** ~17:25

Time of first ranging _____

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	PICKUP LINE HANGING DOWN BY FRAME	
31" syntactic		SURFACED 18:34 BOARDED 18:46	18:50
with Argos Beacon	Y01-008	Beacon ID: 46485 BY BUOY CHAIN BETWEEN FLOATS	↓
34" syntactic		3	
With light	n/a		
Lander frame with			18:51
BPR #1	0085	BANDED ON TRANSOM	↓
BPR #2	0419	—11—	
Acoustic Release #1	823		
Acoustic Release #2	1194		

Ascent Rate _____

Ranging

Time	Range 1	Range 2	Command/comment
1194 17:24:20	—	5177	ARM + ARM
17:24:50	5178	5177	
17:29:33	—	—	ARM + RELEASE
30:16	—	—	
31:00	—	—	
31:50	5025	5013	REL. OK
32:50	4947	4935	
		78 m/min	ETA 18:35

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **MAR0** Cruise **JC145**

NB: all times recorded in GMT

Date 20/3/17 **Site arrival time** OVERNIGHT

Time of first ranging 10:07

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	~~GRAPPLED~~ GRAPPLED 12:12	
Billings Float	n/a	SURFACED LOST BUT ONLY 30 SECONDS LATER	
with Light	W03-096	BILLINGS SNAGGED OFF ON HAULING	
and Argos Beacon	C02-043	Beacon ID: 300234061667220	
~~4~~ x 17" glass	n/a	2 IMPLODED	12:27
MicroCAT	3247 ✓		
MicroCAT	6800 ✓		12:33
~~3 x 17" glass~~	~~n/a~~		no pop off due to pressure
MicroCAT	3259 ✓	line looped over bracket + flooded-top tray	12:39
MicroCAT	6830 ✓	tray edge hit ~~strobe~~ decklesse (non-connector end).	12:44
S4	35612577 ✓		12:44
MicroCAT	3225 ✓		12:50
34' Syntactic	34-02	SURFACED 11:51	12:51
Acoustic Release #1	1198	[redacted] dragged on by hand	12:51
Acoustic Release #2	924		12:51

BILLINGS BOLT UNSCREWED IT SELF FROM THE MAST CONNECTOR

arrested on connector while detaching

Ascent Rate 102 m/min

Ranging

Time	Range 1	Range 2	Command/comment
10 07 15	—	5429	[redacted]
10 08 00	5429	5429	
10 09 10	—	—	
10 10 45	—	—	
10 11 30	—	—	
10 13 ??			
10 17 00	5427	5427	Release OK
10 18 02	5337	5321	
10 19 00	5240	5225	
10 20 00	5138	5126	
10 42 40	3646	3639	
11 01 40	2618	2616	
11 05 00	2442	2437	
11 06 00	2391	2386	5 l/min SLOWED DOWN AS SUSPECT SYNTACTIC HAS OVERTAKEN BILLING WHICH IS NOW ACTING AS A DRAG SLOWING THE ASCENT.

11:36:35	945	942
11:37:35	905	900

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **WB6** Cruise **JC145**

6/4/2017 - 2 spheres on surface ~ 11:10

NB: all times recorded in GMT

Date 5/4/17 **Site arrival time** _____

Time of first ranging ~~10:~~ 10:55

ITEM	SER NO	COMMENT	TIME
Recovery Line	n/a	&	12:52
31" syntactic		Imploded.	12:52
	n/a		"
SBE MicroCAT	6801 ✓		12:51
SBE MicroCAT	6127 ✓		12:47
SBE MicroCAT	6826 ✓	cap broke off	12:40
SBE MicroCAT	5770 ✓		12:33
Nortek	8120 ✓	Tangled.	12:28
SBE MicroCAT	6322 ✓		12:25
31" SYNTACTIC	n/a	hooked between spheres 1211	1215
34" SYNTACTIC	n/a		"
BPR #1	0080		1222
BPR #2	0059		"
Acoustic Release #1	354		"
Acoustic Release #2	1354		"

all muddy

Ascent Rate 72 m/min initially

Time at end of recovery _____

Ranging

Time	Range 1	Range 2	Command/comment
~~1205~~	–	–	
105600	~~5~~448	5448	
110400	5448	–	
111713	5448	5448	Release OK
111813	5389	–	
111943	5279	5266	72 m/min
112113	5172	5163	
120230	4301	4299	
12~~0330~~			14 ~~13~~ m/min MUCH SLOWER
120430	4274	4273	
120730	4234	4233	13 m/min
121030	4196	4195	13 m/min
122906	3986	3986	
123000	3977	3976	9
123400	3941	3940	
1302	3697	3697	
140310	3159	3159	
14:48:15	2876	2875	6 m/min!
14:49:15	2871	2870	
14:57:00	2832	2831	
14:58:00	2826	2826	6 m/min
15:19:17	2686	2686	

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **WB4** Cruise **JC145**

NB: all times recorded in GMT

Date 2/4/2017 **Site arrival time** overnight

Time of first ranging 11 09

ITEM	SER NO	COMMENT	TIME
Recovery Line	n/a	grappled @ 1254.	~1257
3 TRYMSYN floats	n/a		13:01
MicroCAT	4723 ✓	Substantial bio foul	"
MicroCAT-ODO	12999 ✓		"
40" syntactic + ADCP	5599		13:07
with Argos beacon	Y01-012 ✓		"
and light	X01-050 ✓		"
Nortek	5490 ✓		"
MicroCAT	4724 ✓		13:10
49" syntactic	n/a		13:14
with Argos beacon	A08-076 ✓		"
and light	W03-091 ✓		"
MicroCAT	5243 ✓		13:21
Nortek	5611 ✓		"
MicroCAT	4070 ✓		13:22
MicroCAT-ODO	12962 ✓		"
MicroCAT	4071 ✓		13:29
Nortek	5889 ✓		13:35
MicroCAT	5784 ✓		13:37
MicroCAT-ODO	12963 ✓		"
MicroCAT	6117 ✓	Tangled.	13:48
2 x Yellow CF-16s	n/a		"
10 x Orange CF-16s	n/a		"
Nortek	5831 ✓		"
MicroCAT	5981 ✓		"
Nortek	5893 ✓		14:00
MicroCAT-ODO	12964 ✓		"
5 x yellow CF-16s	n/a	Tangled into a loop.	14:04
MicroCAT	4471 ✓		14:07
5 x yellow CF-16s	n/a		14:17
Nortek	5955 ✓		"
MicroCAT	3282 ✓		14:21
MicroCAT-ODO	12965 ✓		"
5 x yellow CF-16s	n/a		14:34
MicroCAT	4464 ✓		14:37
5 x yellow CF-16s	n/a		14:49

Nortek	5963 ✓	DRUM CHANGED winding again @ 500	14:50
MicroCAT	6804 ✓		15:01
5 x yellow CF-16s	n/a		15:14
MicroCAT	6798 ✓		15:18
MicroCAT-ODO	12966 ✓		"
5 x yellow CF-16s	n/a		15:31
Nortek	6050 ✓		"
MicroCAT	3913 ✓		15:33
MicroCAT	6824 ✓		15:46
Nortek	6088 ✓		15:50
10 x glass	n/a	4 imploded.	15:52
Acoustic Release 1	927		15:55
Acoustic Release 2	319		"

Ascent Rate n/a

Time at end of recovery 15:55

Ranging

Time	Range 1	Range 2	Command/comment
11 09 30	—	—	
" 10 30	4691	4693	
" 11 10	—	4708	
" 11 40	4713	4717	
" 57 50	4696	4696	
12 02 50	241	3021	Release OK
" 03 30	4694	918	" "
" 04 10	2218	65	" "
" " 50	4570	4555	spotted on surface

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **WB4L10** Cruise **JC145**

NB: all times recorded in GMT

Date 2/4/17 **Site arrival time** 16:05

Time of first ranging 16:17

ITEM	SER NO	COMMENT	TIME
Recovery Line	n/a	ON SURFACE 17:47 GRAPPLED 17:55	17:55
Billings float	n/a		17:58
4 x 17" glass	n/a	ONLY 1 PACK OF GLASS ON SURFACE	18:03
4 x 17" glass	n/a		18:07
4 x 17" glass	n/a	ALL 4 IMPLODED	18:08
BPR #1	0039		18:10
BPR #2	0040		↓
Acoustic Release #1	358		↓
Acoustic Release #2	1732		↓

Ascent Rate 53 m/min

Time at end of recovery 18:10

Ranging

Time	Range 1	Range 2	Command/comment
16:17:50	/	4659	ARM + ARM
16:18:30	4659	4659	
16:19:03	/	4659	ARM + ARM
16:19:52	4660	4659	ARM + REL OK.
16:20:50	4624	4616	
16:21:50	4571	4563	53 m/min
16:25:05	4400	4393	ARM + ARM
16:26:05	4346	4340	
17 22 20	1413	1409	
17 23 50			
17 24 40	1297	1284	

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **WBH2** Cruise **JC145**

NB: all times recorded in GMT

Date 31/03/2017 **Site arrival time** Overnight

Time of first ranging 10.54

ITEM	SER NO	COMMENT	TIME
Recovery Line	n/a	grappled @ 13 33 ½	13:50
Billings float	n/a	Tangled	13:55
12x 17" glass	n/a	SPOTTED @31	"
RAS-500	13278-02		"
Nortek	6805 ✓		"
MicroCAT-ODO	12967 ✓		14:01
MicroCAT-ODO	12968 ✓		14:14
7 x 17" glass	n/a		14:19
Nortek	8502 ✓		"
MicroCAT	6822 ✓		14:22
5 x 17" glass	n/a		14:42
Nortek	9420 ✓		"
MicroCAT	6326 ✓		14:46
MicroCAT-ODO	12998 ✓		14:59
5 x 17" glass	n/a		15:07
Swivel	n/a		"
Nortek	9204 ✓		"
MicroCAT	5239 ✓		15:10
MicroCAT	5983 ✓		15:23
5 x 17" glass	n/a		15:30
Nortek	9210 ✓		"
MicroCAT	5982 ✓	Cable tangled	15:34
6x 17" glass	n/a		"
Acoustic Release #1	365 ✓	[redacted]	15:39
Acoustic Release #2	910 ✓		

Ascent Rate 72 m/min

Time at end of recovery 15:39

Ranging

Time	Range 1	Range 2	Command/comment
105400	–	4772	
" " 40	4770	4769	
" 55 30	–	–	
" 5615	–	–	
" 5700	–	–	
120343	/	/	ECHOSOUNDER STILL ON
120410	/	4769	ARM + ARM
120530	/	/	ARM + REL
120615	/	/	ARM + REL
120701	/	/	
120801	/	/	ARM + ARM
120840	/	/	
121000	/	/	ARM + REL
121050	4370	/	
121150	/	4273	
121250	/	/	
121350	/	11643	
121452	/	11610	
121550	/	11571	
121700	/	/	ARM + ARM
121750	3866	3861	

BRIDGE SAID THRUSTERS WORKING QUITE A BIT.

72 m/min

ETA 12:28 IF WE GOING UP IN LINE.

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **WB2** Cruise **JC145**

NB: all times recorded in GMT

Date 29/03/2017 **Site arrival time** overnight

Time of first ranging 1059.

ITEM	SER NO	COMMENT	TIME
Recovery Line	n/a	grappled @ 1238, fouled	1242
3 x Trymsyn floats	n/a	"	1244
MicroCAT	4180 ✓	"	"
30" SYNTACTIC		"	1250
~~Iridium~~ ARGOS	Z02-005	AERIAL MISSING "	"
Light	A08-080 ✓	"	"
Nortek	9213 ✓	"	"
MicroCAT	4470 ✓		12:52
51" syntactic	n/a		12:55
~~ARGOS~~ ~~Iridium~~ ARGOS	286 ✓	SIGNALS RECEIVED, SO TRANSMITTING.	
Light	Z02-019 ✓		
Nortek	9435 ✓		"
MicroCAT	3223 ✓	last of biofouled	12:58
MicroCAT	3232 ✓		13:02
2 x 17" glass	n/a		13:04
Nortek	8483 ✓		"
MicroCAT	6814 ✓		13:09
MicroCAT	6121 ✓		13:14
2 x 17" glass	n/a		13:17
Nortek	~~8502~~ 8052 ✓		"
MicroCAT	6803 ✓		13:22
MicroCAT	3270 ✓		13:28
10 x 17" glass	n/a		13:36
Swivel	n/a		"
Nortek	8492 ✓		13:33
MicroCAT	6137 ✓		13:38
Nortek	11024 ✓		13:43
MicroCAT	6808 ✓		"
5 x 17" glass	n/a		13:50
MicroCAT	4068 ✓		13:53
MicroCAT	6821 ✓		13:59
Nortek	6534 ✓		14:03
5 x 17" glass	n/a		14:11
MicroCAT	5782 ✓		14:14
MicroCAT	6128 ✓		14:27

2 x 17" glass	n/a		14:33
Nortek	6747 ✓		"
5 x 17" glass	n/a	2 imploded	14:42
MicroCAT	6325 ✓		14:55
MicroCAT	6335 ✓		15:08
10 x 17" glass	n/a		15:10
Acoustic Release #1	907 ✓	ARM:	15:13
Acoustic Release #2	253 ✓	ARM:	"

Ascent Rate

Time at end of recovery 15:13

Ranging

Time	Range 1	Range 2	Command/comment
105920	–	–	
110040	3894	3893	
110135	–	–	
" 0220	3894	–	
" " 50	–	–	
120220	–	3895	
120340	–	11933	Prob release ✱ command.
" 0450	3801	–	On surface.

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **WB1** Cruise **JC145**

NB: all times recorded in GMT

Date 28/3/2017 **Site arrival time** 1401

Time of first ranging 13:18

ITEM	SER NO	COMMENT	TIME
Recovery Line	n/a	grappled @ 14.36.	1436
30" syntactic	n/a	Heavily fouled.	14:43
2 x 17" glass	n/a	" "	"
RAS-500 with	13278-04		14:49
Controls	CO2-1114-003		"
SeaFET	003		"
MicroCAT ODO	12903	+RBR 100277	"
MicroCAT	3239		"
6 x 17" glass	n/a		14:52
Nortek	9427 ✓		14:54
MicroCAT	~~4072~~ 5985		14:55
RBR-SoloT	100279 ✓		14:57
RBR-SoloT	100261 ✓		14:59
45" syntactic	n/a		15:01
RBR-SoloT	100257 ✓		15:03 (?)
RBR-SoloT	100262 ✓		15:04
RBR-SoloT	100260 ✓		15:06
Nortek	6723 ✓		15:08
MicroCAT	4072 ✓		"
MicroCAT-ODO	12911 ✓		"
RBR-SoloT	100274 ✓		15:12
RBR-SoloT	100265 ✓		15:14
RBR-SoloT	100266 ✓		15:15
RBR-SoloT	100275 ✓		15:17
RBR-SoloT	100259 ✓		15:19
45" Syntactic and ADCP	5575		15:21
ADCP (down looking)	15579	lowered onto transducer head.	15:25
RBR-SoloT	100269 ✓		15:28
RBR-SoloT	100271 ✓		15:30
Nortek	5879 ✓		15:32
MicroCAT	6123 ✓		"
MicroCAT-ODO	13000 ✓		"
RBR-SoloT	100273 ✓		"
RBR-SoloT	100276 ✓		15:36
RBR-SoloT	100258 ✓		15:38

RBR-SoloT	100267 ✓		15:39
RBR-SoloT	100272 ✓		15:41
RBR-SoloT	100264 ✓		15:43
RBR-SoloT	100255 ✓		15:45
RBR-SoloT	100268 ✓		15:47
2 x 17" glass	n/a ✓		15:48
Nortek	5884 ✓		"
MicroCAT	6120 ✓		15:51
RBR-SoloT	100270 ✓		15:53
RBR-SoloT	100256 ✓		15:54
RBR-SoloT	100278 ✓		15:56
7 x 17" glass	n/a	Tangled	15:58
Acoustic release #1	498		16:01
Acoustic release #2	318		"

Ascent Rate _____

Time at end of recovery _____

Ranging

	Time	Range 1	Range 2	Command/comment
498	13:18:05	—	2896	ARM + PING DURING CTD TO N.E.
	13:18:35	2898	2897	
318	13:19:25	—	2896	ARM + DIAG VERTICAL 12.7V
	14 01 51	—	—	
	1403	1465		
	1405	1446	1445	
	1411	1435	1436	
	141225	1436	1437	Release OK
	" 56	1411	1399	" "

1414 @ surface

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **WBADCP** Cruise **JC145**

NB: all times recorded in GMT

Date 28/3/2017. **Site arrival time** 1641

Time of first ranging 1641

surfaced @ 1656

ITEM	SER NO	COMMENT	TIME
Recovery Line	n/a		1708
ADCP in float	10311	(float sn: 40-01)	17:12
Acoustic Release #1	821		17:15
Acoustic Release #2	1197	corrosion on bottom	"

Ascent Rate ~90 m/min plus slant inaccuracy.

Time at end of recovery 1718

Ranging

Time	Range 1	Range 2	Command/comment
1641 -	305	28	BATHY ON, 821
164150	-	802	
164230	806	805	"
164310	-	813	1197
	826		
165045	826	825	Release OK
165117	-	801	" "
" " 30	779	770	" "
" 5230	693	684	~90 m/min

sn 821 ? Arial [redacted]

sn 1197 ? Arial [redacted]

RAPID-WATCH MOORING LOGSHEET **RECOVERY**

Mooring **WBAL5** Cruise **JC145**

NB: all times recorded in GMT

Date 28/3/2017 **Site arrival time** _____

Time of first ranging _____

ITEM	SER NO	COMMENT	TIME
Recovery Line	n/a		
Billings float	n/a		
4 x 17" glass	n/a		
4 x 17" glass	n/a		
4 x 17" glass	n/a		
BPR #1	0417		
BPR #2	0390		
Acoustic Release #1	1406	[redacted]	
Acoustic Release #2	1464		

Ascent Rate _____

Time at end of recovery _____

Ranging

Time	Range 1	Range 2	Command/comment
1808	1181	—	
1809	791	8703	
1810	—	—	
1811	—	—	
1812	—	—	
1813	790		
181440	791	793	Release OK
" 1512	791	790	" "
" 1600	791	791	" "
" 1652	—	—	
" 1741	—	—	
" 1951	791	794	
" 2104	790	791	
2350	790	791	
182500	—	—	
	—	—	
182900	790	791	VERT, 8.1V
193130	1390	1391	
" 3220	1390	1390	VERT, VBATT 8.1
" 3323	—	—	
" 3420	—	—	
" 3540	1390	1389	VERT, 8.1V
032750	1960	1950	
" 2830	1951	1951	

Appendix C: Logsheets of deployed moorings

RAPID-AMOC MOORING LOGSHEET **DEPLOYMENT**

Mooring **EBH4** Cruise **JC145**

NB: all times recorded in GMT

Date 1/3/17 **Site arrival time** _____

Setup distance _____

Start time 14:37 **End time** 15:49

Start Position

Latitude 27° 50.208 N **Longitude** 13° 33.502 W

ITEM	SER NO	COMMENT	TIME
McLane-12"	n/a		14:37
Recovery line	n/a		"
Billings 3 sphere	n/a		"
with Light	E03-033	INV. 25000 7204	"
Argos or Iridium Beacon	~~300234063653770~~	Beacon ID = 300234063653770	"
4 x 17" glass	n/a	Z08-051	"
SBE37 SMP	5980		14:40
SBE37 SMP	5986		14:43
3 x 17" glass	n/a		14:47
SBE37 SMP	5786		14:48
SBE37 SMP	5787		14:51
2 x 17" glass	n/a		14:55
SBE37 SMP	6124		14:57
SBE37 SMP	5990		15:00
2 x 17" glass	n/a		15:05
SBE37 SMP	6320		15:06
SBE37 SMP	6331		15:09
2 x 17" glass	n/a		15:14
SBE37 SMP	6806		15:15
RCM11	0395		15:21
SBE37 SMP	5988		15:23
Swivel-SS	n/a		15:27
6 x 17" glass	n/a		15:27
Acoustic Release #1	1242	Record codes below	15:30
Acoustic Release #2	1352	Record codes below	15:30
600kg Anchor	n/a		15:49

Release #1 arm code [redacted]

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID _____

Argos beacon #2 ID _____

Anchor Drop Position

Latitude 27° 51'.059 N **Longitude** 13° 32'.357 W

Uncorrected water depth 1052 (at anchor launch)
Corrected water depth 1056 (at anchor launch)

Triangulation Sheet

WATCHING DOWN

Location (e.g. 1, 2 3)	Release SN or ARM	Time	Latitude	Longitude	Range 1 (m)	Range 2 (m)
[illegible]		05:59:02			1105	1106
		05:59:30			1105	1105
1	1242	16:52:40			3067	3066
		16:53:01			3066	3066
2	1242	17:28:20			3816	3815
		17:28:40			3812	3811
		175115			1591	
		175200			1607	1611

RAPID-AMOC MOORING LOGSHEET **DEPLOYMENT**

Mooring **EBH4L7** Cruise **JC145**

NB: all times recorded in GMT

Date 1/3/17 **Site arrival time** _____

~~Setup distance~~ _____

Start time 13:26 **End time** 13:32

Start Position

Latitude _____ **Longitude** _____

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		13:26
McLane-12"	n/a		13:26
Billings 4 sphere	n/a		"
with Light	D03-072		"
Argos or Iridium Beacon	B11-022	Beacon ID =	"
4 x 17" glass	n/a		13:28
4 x 17" glass	n/a		13:28
4 x 17" glass	n/a		13:29
SBE26/53 ~~0447~~	0447		13:31
SBE26/53	0003		"
Acoustic Release #1 (tripod)	1347	Record codes below	"
Acoustic Release #2 (tripod)	1349	Record codes below	"
600kg Anchor	n/a		"

Release #1 arm code [redacted]
Release #1 release code
Release #2 arm code
Release #2 release code
Argos beacon #1 ID _____
Argos beacon #2 ID _____

Anchor Drop Position
Latitude 27°52.146' N **Longitude** 13° 30.649' W

Uncorrected water depth 989 m (at anchor launch)
Corrected water depth 993 m (at anchor launch)

RAPID-AMOC MOORING LOGSHEET **DEPLOYMENT**

Mooring **EBH3** Cruise **JC145**

NB: all times recorded in GMT

Date 2/3/17 **Site arrival time** ~10:45

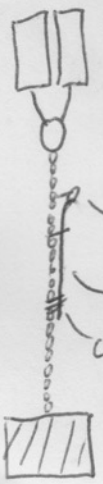
Setup distance 1.5 NM

Start time 11.02 **End time** 12:40

Start Position

Latitude 27° 47.26 N **Longitude** 13° 45.76 W

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		11:02
McLane-12"	n/a		"
Billings 3 sphere	n/a		"
with Light	D03-071		"
Argos or Iridium Beacon	E03-034	Beacon ID = 300234063269820	"
4 x 17" glass	n/a		"
SBE37 SMP	5978		"
SBE37 SMP	3248		11:08
SBE37 SMP	6321		11:12
SBE37 SMP	6323		11:15
3 x 17" glass	n/a		Hi19
SBE37 SMP	7363		11:21
SBE37 SMP	5989		11:24
5 x 17" glass	n/a		11:28
Nortek	8465	Order Swapped NORTEK FACING DOWN	11:34
SBE37 SMP	5763		11:34
SBE37 SMP	4062		11:38
4 x 17" glass	n/a		11:43
SBE37 SMP	5991		11:45
Nortek	11846	NORTEK FACING DOWN BENEATH MC	1159
SBE37 SMP	5993		1159
3 x 17" glass	n/a		1204
SBE37 SMP	4060		1207
Nortek	11855		1211
SBE37 SMP	7361		12:14
3 x 17" glass	n/a		12:18
SBE37 SMP	5992		12:22
Nortek	12701		12:29
SBE37 SMP	6805		12:33
Swivel-SS	n/a		12:36
4 x 17" glass	n/a		"
Acoustic Release #1	1461	Record codes below	
Acoustic Release #2	1463	Record codes below	
1200kg Anchor	n/a		12:40



Rope snagged when slipping releases. outboard. Had to be cut and end was ~~the~~ cable tied down anchor chain to reduce risk of tangling with releases above

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____

Release #2 release code _____

Argos beacon #1 ID _____

Argos beacon #2 ID _____

Anchor Drop Position

Latitude 27° 48.614' N **Longitude** -13° 44.717' W

Uncorrected water depth 1418 (at anchor launch)

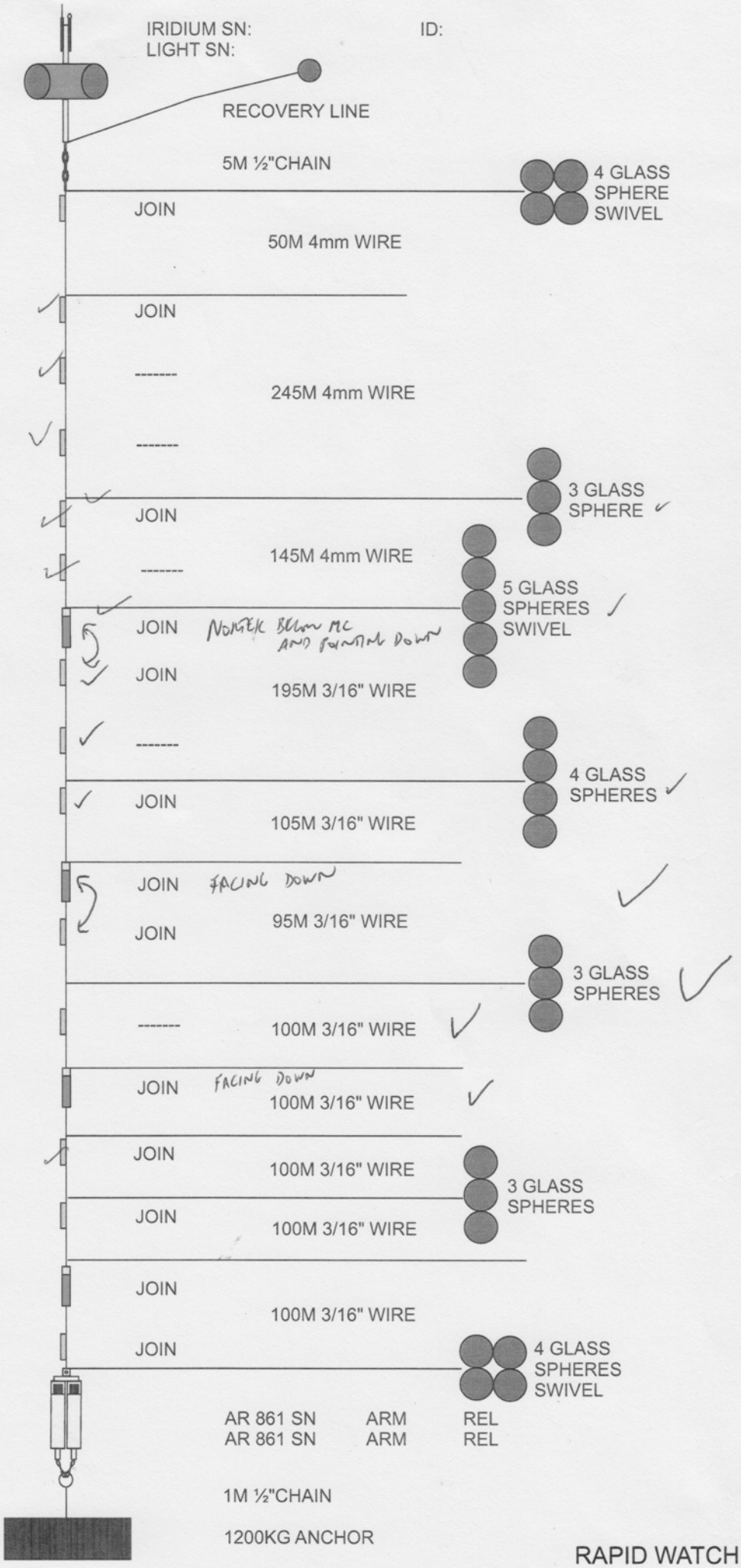
Corrected water depth ~~1409~~ 1420 (at anchor launch)

Triangulation Sheet

Location (e.g. 1, 2 3)	Release SN or ARM	Time	Latitude	Longitude	Range 1 (m)	Range 2 (m)
		12:57:00			1466	1468
		12:58:35			1500	1502
(1)		13:06:30			2079	2088
		13:06:45			2103	2112
		13:07:40			2185	2194
(2)		13:22:55			2003	2009
		13:23:10			2019	2029
(3)		13:37:02			1966	1976
		13:37:20			1992	2002

MOVING TO FIRST POINT

EBH3
TO DEPLOY
2017



WATER DEPTH
1400M

RAPID WATCH

RAPID-AMOC MOORING LOGSHEET **DEPLOYMENT**

Mooring **EBH2** Cruise **JC145**

NB: all times recorded in GMT

Date 2/3/17 **Site arrival time** ~17:30

Setup distance 0.3 miles

Start time 18:33 **End time** 18:51

Start Position

Latitude ~~27 36.840~~ **Longitude** ~~14.12.65~~ 14° 12.526' W

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		18:33
McLane 12"	n/a		
3 x Billings sphere	n/a		
with Light			
Argos or Iridium Beacon	GET FROM PAUL	Beacon ID =	
2 x 17" glass	n/a		18:35
SBE37 SMP	6840		
2 x 17" glass	n/a		18:40
SBE37 SMP	4066		"
RCM-11	383		18:42
SBE37 SMP	6815		18:44
4 x 17" glass	n/a		
Swivel	n/a		
Acoustic Release #1	324	Record codes below	
Acoustic Release #2	1405	Record codes below	
500kg Anchor	n/a		18:51

Release #1 arm code [redacted]

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID

Argos beacon #2 ID

Anchor Drop Position

Latitude 27° 36.899' N **Longitude** 14° 12.640' W

Uncorrected water depth 2018 (at anchor launch)

Corrected water depth 2018 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **EBH1** Cruise **JC145**

NB: all times recorded in GMT

Date 03.08.17 **Site arrival time** ~12:00

Setup distance 430m

Start time 13:32 **End time** 13:55

Start Position

Latitude 27° 13.~~333~~ 125 N **Longitude** 15° 25.471 W

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		13:32
3 x Billings sphere	n/a		13:33
with Light	Z08-052		"
~~Argos or~~ Iridium Beacon	E03-035	Beacon ID = 300234063352630	"
2 x 17" glass	n/a		13:34
SBE37 SMP	6125		"
2 x 17" glass	n/a		13:42
RCM11	305		13:46
SBE37 SMP	4849		13:48
4 x 17" glass	n/a		13:49
Swivel-SS	n/a		
Acoustic Release #1	145	Record codes below	
Acoustic Release #2	246	Record codes below	
500kg Anchor	n/a		13:55

Release #1 arm code [redacted]

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID

Argos beacon #2 ID

Anchor Drop Position

Latitude 27° 13.333 N **Longitude** 15° 25.361 W

Uncorrected water depth 3036 (at anchor launch)

Corrected water depth 3039 (at anchor launch)

Triangulation Sheet

Location (e.g. 1, 2 3)	Release SN or ARM	Time	Latitude	Longitude	Range 1 (m)	Range 2 (m)
		14 1400			1908	1917
	"	142000			2485	2494
		143045			3035	3035

Descent rate 1.6 m/s

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **EBH1L** Cruise **JC145**

NB: all times recorded in GMT

Date 3/3/17 **Site arrival time** ~11:30

Setup distance /

Start time 11:35 **End time** 11:45

Start Position

Latitude 27° 12.108'N **Longitude** 15° 25.070'W

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		11:38
McLane-12"	n/a		"
Billings 4 sphere	n/a		11:39
with Light	D01 - 049		"
Argos or Iridium Beacon	B11-023	Beacon ID = 134364	"
4 x 17" glass	n/a		11:40
4 x 17" glass	n/a		11:40
4 x 17" glass	n/a		11:41
SBE26/53	~~n/a~~ 0448	Frame bumped ship	11:45
SBE26/53	0004		"
Acoustic Release #1 (tripod)	1203	Record codes below	"
Acoustic Release #2 (tripod)	1350	Record codes below	"
600kg Anchor	n/a		"

Release #1 arm code [redacted]

Release #1 release code [redacted]

Release #2 arm code [redacted]

Release #2 release code [redacted]

Argos beacon #1 ID ~~13464~~ 134364

~~Argos beacon #2 ID~~

Anchor Drop Position

Latitude 27° 12.247'N **Longitude** 15° 25.009'W

Uncorrected water depth 3028 (at anchor launch)

Corrected water depth 3031 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **EBHi** Cruise **JC145**

NB: all times recorded in GMT

Date 05.03.17 **Site arrival time** 13:20

Setup distance 1 mile

Start time 13:43 **End time** 14:34

Start Position

Latitude 24°55.85'N **Longitude** 21° 16.56' W

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		13:43
Billings float	n/a		13:44
with Light	B08-084	ID = 300234063788890	"
Argos or Iridium Beacon	E03-036	Beacon ID = ~~B08-084 E03-036~~	"
2 x 17" glass	n/a		13:45
SBE37 MicroCAT	5246		"
2 x 17" glass	n/a		14:07
SBE37 MicroCAT	6919		"
RCM11	303		14:19
SBE37 MicroCAT	6828		14:22
4 x 17" glass	n/a		"
Acoustic Release #1	1345	Record codes below	14:33
Acoustic Release #2	1733	Record codes below	"
300kg Anchor	n/a		"

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____

Release #2 release code _____

Anchor Drop Position

Latitude 24° 56.21'N **Longitude** 21° 15.88'W

Uncorrected water depth 4440 m (at anchor launch)

Corrected water depth _____ (at anchor launch)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **EB1** Cruise **JC145**

NB: all times recorded in GMT

Date 10/3/17 **Site arrival time** OVERNIGHT

Setup distance 5 miles

Start time 13:05 **End time** _____

Start Position

Latitude 23° 40.34'N **Longitude** 24° 10.97'W

ITEM	SER NO	COMMENT	TIME
Mini-Trimsyn	n/a		13:05
24.5" syntactic float	n/a 24-03		13:07
with Light	408-085		|
~~Argos~~ or Iridium Beacon	C02-045	Beacon ID = 300234061661040	|
8 x 17" glass (parallel)	n/a		13:10
RAS-500	ML 14082-01		13:16
Contros pCO2	C02-0812-020		|
SeaFET	103		|
Swivel-SS	n/a		|
MC-SMP-ODO	1452		|
SBE37 IMP	3902		|
SBE37 IMP	4797		13:21
37" McLa. SS	37-05		13:29
with Light	B11-019		"
Argos or ~~Iridium~~ Beacon	Y01-027	Beacon ID = 46500	|
Swivel-SS	n/a		|
SBE37 SMP	3486		|
SBE37 SMP	4800		13:32
SBE37 SMP	3264		13:36
SBE37 SMP	3911		13:46
MC-SMP-ODO	10519		"
4 x 17" glass	n/a		13:46
SBE37 SMP	3483		13:50
4 x 17" glass	n/a		13:59
SBE37 SMP	3928		14:01
MC-SMP-ODO	10547		"
SBE37 SMP	4305		14:07
4 x 17" glass	n/a		14:14
SBE37 SMP	3910		14:19
RCM11	451	} these were switched.	14:25
MC-SMP-ODO	10517		14:29
4 x 17" glass	n/a		14:34
SBE37 SMP	3934		14:36
MC-SMP-ODO	10545	} switched	14:48
SBE37 SMP	5773		14:48

5 x 17" glass	n/a	marker over shackles nicked coating of wire (taped it up)	15:03
SBE37 SMP	3271		15:09
SBE37 SMP	3265		15:24
5 x 17" glass	n/a		15:34
MC-SMP-ODO	10546		15:44
SBE37 SMP	5768		15:44
4 x 17" glass	n/a		15:58
SBE37 SMP	3251		16:02
4 x 17" glass	n/a		16:18
SBE37 SMP	4799		16:21
RCM11			16:40
SBE37 SMP		~ 5-10m below RCM11.	16:42
8 x 17" glass	n/a		16:52
Acoustic Release #1	322	Record codes below	17:48
Acoustic Release #2	1491	Record codes below	17:48
1600kg Anchor	n/a		17:51

Release #1 arm code _____
Release #1 release code _____
Release #2 arm code _____
Release #2 release code _____
Argos beacon #1 ID _____
Argos beacon #2 ID _____

Anchor Drop Position
Latitude 23°45.64' **Longitude** 24°09.44'

Uncorrected water depth 5045 (at anchor launch)
Corrected water depth _____ (at anchor launch)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **EB1L12** Cruise **JC145**

NB: all times recorded in GMT

Date 9/3/17 **Site arrival time** _____

Setup distance _____

Start time 16:38 (Hydraulics issue) **End time** 17:01

Start Position 16:53

Latitude _____ **Longitude** _____

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		16:53
McLane-12"	n/a		"
Billings float	n/a		16:54
with Light	X01-048		/
Argos or ~~Iridium~~ Beacon	Y01-011	Beacon ID = 46493	/
4 x 17" glass	n/a		16:54
4 x 17" glass	n/a		16:55
4 x 17" glass	n/a		16:56
SBE26/53	0449		16:59
SBE26/53	0435		/
Acoustic Release #1 (tripod)	~~0464~~ 919	Record codes below	/
Acoustic Release #2 (tripod)	1731	Record codes below	/
600kg Anchor	n/a	dropped	17:01

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____ — TRICKY TO SEE

Release #2 release code _____

Argos beacon #1 ID 46493

Argos beacon #2 ID _____

Anchor Drop Position

Latitude 23° 48.00' N **Longitude** 24° 8.50' N

Uncorrected water depth 5050.5m (at anchor launch)

Corrected water depth _____ (at anchor launch)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **NOG** Cruise **JC145**

NB: all times recorded in GMT

Date 14/3/17 **Site arrival time** ~13:00

Setup distance 1.5 miles

Start time 14:08 **End time** 15:36

Start Position

Latitude 23° 44.35' N **Longitude** 41° 07.00' W.

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		14:08
Billings Float	n/a		14:09
with Light	603-095		"
12 x 17" glass	n/a		14:11
Swivel	n/a		
Sediment Trap	12283-62		14:16
Nortek	8421	Light bumps against side on way in.	"
Sediment Trap	12432-01		14:23
Nortek	8430		"
10 x 17" glass	n/a		14:56
MicroCAT	3280		15:06
Acoustic Release #1	2481		"
Acoustic Release #2	282		"
850kg Anchor	n/a		15:36

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____

Release #2 release code _____

Argos beacon #1 ID _____

Argos beacon #2 ID _____

Anchor Drop Position

Latitude 23° 45.33' N **Longitude** 41° 05.74' W

Uncorrected water depth _____ (at anchor launch)

Corrected water depth _____ (at anchor launch)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **MAR3** Cruise **JC145**

NB: all times recorded in GMT

Date 15/03/17 **Site arrival time** 16:50

Setup distance 3.5 miles

Start time 17:34 **End time** 21:59

Start Position

Latitude 23° 50.15' N **Longitude** 41° 08.67' W

ITEM	SER NO	COMMENT	TIME
Pickup float	n/a		17:34
3 x Mini-Trimsyn	n/a		"
SBE37 MICROCAT	3254		17:34
24.5" syntactic float	n/a 24-02		17:38
with Light	501-185		"
and ~~Argos~~ Iridium Beacon	603-037	Beacon ID = ... 063352490	"
SBE37 MICROCAT	6818		"
37" McLa. SS	37-06		17:43
with Light	TJS-079	Hit side of ship softly	"
and Argos Beacon	094	Beacon ID = 24027	"
Swivel-SS	n/a		
SBE37 MICROCAT	6817		17:45
SBE37 MICROCAT	6115		17:48
SBE37 MICROCAT	3257		17:51
SBE37 MICROCAT	4307		17:54
SBE37 MICROCAT	5779		18:00
10 x 17" glass	n/a		18:09
SBE37 MICROCAT	4710		18:11
SBE37 MICROCAT	3214		18:16
SBE37 MICROCAT	5484		18:23
RCM11	448		18:33
SBE37 MICROCAT	3268		18:37
9 x 17" glass	n/a		18:46
Swivel-Ti	n/a		"
SBE37 MICROCAT	3893		18:52
4 x 17" glass	n/a		19:06
SBE37 MICROCAT	4306		19:09
4 x 17" glass	n/a		1928
SBE37 MICROCAT	3230		1929
4 x 17" glass	n/a		1943
SBE37 MICROCAT	3209		1946
4 x 17" glass	n/a		20:01
SBE37 MICROCAT	5485		20:04
SBE37 MICROCAT	7470		20:17
4 x 17" glass	n/a		20:24

SBE37 MICROCAT	7362		20:33
S4			20:37
7 x 17" glass	n/a		20:39
Swivel-Ti	n/a		
Acoustic Release #1	2228	Record codes below	20:43
Acoustic Release #2	2244	Record codes below	20:43
1800kg Anchor	n/a		21:59

Release #1 arm code _____
Release #1 release code _____
Release #2 arm code _____
Release #2 release code _____
Argos beacon #1 ID _____
Argos beacon #2 ID _____

Anchor Drop Position
Latitude 23°52.35'N **Longitude** 41°05.08'W

Uncorrected water depth 5025 ? VARYING SO CHECK DATA. (at anchor launch)
Corrected water depth _____ (at anchor launch)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **MAR3L11** Cruise **JC145**

NB: all times recorded in GMT

Date 15/3/17 **Site arrival time** ~~15:44~~ 15:52

Setup distance ✓

Start time 15:56 **End time** 16:01

Start Position

Latitude _____ **Longitude** _____

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		~~15:56~~
MeLane-12"	n/a		
~~Billings 4 sphere~~	n/a		
with Light	A08-087		
Argos or ~~Iridium~~ Beacon	Y01-009	Beacon ID = 46491	
31" syntactic + ~~Light~~ ANM	31-10		15:58
34" syntactic + ~~Light~~ LLM	34-03		16:00
Lander frame with	n/a		16:01
SBE~~26~~/53	0056		
SBE~~26~~/53	0426		
Acoustic Release #1	2219	Record codes below	
Acoustic Release #2	265	Record codes below	
600kg Anchor	n/a		

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____

Release #2 release code _____

Argos beacon #1 ID _____

Argos beacon #2 ID _____

Anchor Drop Position

Latitude _____ **Longitude** _____

Uncorrected water depth _____ (at anchor launch)

Corrected water depth _____ (at anchor launch)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **MAR1** Cruise **JC145**

NB: all times recorded in GMT

Date 19/3/17 **Site arrival time** OVERNIGHT

Setup distance 4.5 MILES

Start time 12:34 **End time** _____

Start Position

Latitude 24° 10.04'N **Longitude** 49° 49.93

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		12:34
Mini-Trimsyn	n/a		"
24.5" syntactic float		IMS number 250001782	12:36
with Light	A08-082		"
~~Argos~~ or Iridium Beacon	C02-047	Beacon ID = ~~300234061668230~~ 300234061668230	"
8 x 17" glass	n/a		"
RAS-500	13278-01		12:41
Contros pCO2	62-0812-005	+ HYDRO-B BAT-CL-0715-004	"
SeaFET	104		"
~~Swivel-SS~~	n/a		"
MC-SMP-ODO	14150		"
SBE37 MICROCAT	3890 ✓		"
SBE37 MICROCAT	3912		12:44
37" McLa. SS	37-03		12:48
with Light			"
Argos or ~~Iridium~~ Beacon	401-026	Beacon ID = 46499	"
Swivel-SS	n/a		"
SBE37 MICROCAT	3249		12:50
SBE37 MICROCAT	5765		12:54
SBE37 MICROCAT	3207		12:57
MC-SMP-ODO	10518		13:01
SBE37 MICROCAT	5780		"
SBE37 MICROCAT	6827		13:07
9 x 17" glass	n/a		13:16
MC-SMP-ODO	14114		13:19
SBE37 MICROCAT	3244		"
SBE37 MICROCAT	3216		13:25
SBE37 MICROCAT	3213		13:30
RCM-11	445		13:40
MC-SMP-ODO	14115		13:42
SBE37 MICROCAT	3252		13:46
12 x 17" glass	n/a		13:56
Swivel-Ti	n/a		"
MC-SMP-ODO	14148		14:07
SBE37 MICROCAT	5785		14:06

IN FRAME

8 x 17" glass	n/a		14:24
SBE37 MICROCAT	6825		14:27
SBE37 MICROCAT	6820		14:42
3 x 17" glass	n/a		14:57
MC-SMP-ODO	10520		15:03
SBE37 MICROCAT	4178		15:06
4 x 17" glass	n/a		15:22
SBE37 MICROCAT	6333		15:25
SBE37 MICROCAT	3933		15:37
4 x 17" glass	n/a		15:56
SBE37 MICROCAT	3277		16:05
S4	356 125 72		16:11
9 x 17" glass	n/a		16:18
Swivel-Ti	n/a		
Acoustic Release #1	2223	Record codes below	17:16
Acoustic Release #2	2226	Record codes below	17:16
2100kg Anchor	n/a		17:20

Release #1 arm code _____
Release #1 release code _____
Release #2 arm code _____
Release #2 release code _____
Argos beacon #1 ID _____
Argos beacon #2 ID _____

Anchor Drop Position
Latitude 24° 10.00' N **Longitude** 49° 44.69' W

Uncorrected water depth ~~5161~~ 5161 (at anchor launch)
Corrected water depth 5211 (at anchor launch)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **MAR1L11** Cruise **JC145**

NB: all times recorded in GMT

Date ~~17/3/17~~ 18/3/17 **Site arrival time** 17:00

Setup distance ~

Start time _____ **End time** _____

Start Position

Latitude _____ **Longitude** _____

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		17:09
McLane-12"	n/a		↓
31" syntactic float	n/a 31-07		17:10
~~with Light~~			
Argos or ~~Iridium~~ Beacon	Y01-013	Beacon ID = 46498	
34" syntactic float	n/a J08352-00	(34-04)	17:12
with Light	Y01-014		
~~Argos or Iridium~~ Beacon		Beacon ID =	
SBE26/53	0432		17:19
SBE26/53	0034		↓
Acoustic Release #1 (tripod)	2229	Record codes below	
Acoustic Release #2 (tripod)	2243	Record codes below	
600kg Anchor	n/a		↓

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____

Release #2 release code _____

Argos beacon #1 ID _____

Argos beacon #2 ID _____

Anchor Drop Position

Latitude _____ **Longitude** _____

Uncorrected water depth _____ (at anchor launch)

Corrected water depth _____ (at anchor launch)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **MAR0** Cruise **JC145**

NB: all times recorded in GMT

Date 29/03/2017 **Site arrival time** 13:40

Setup distance _____

Start time 14:27 **End time** 14:52

Start Position

Latitude 25° 8.64' **Longitude** 52° 1.52'

ITEM	SER NO	COMMENT	TIME
McLane-12"	n/a		14:27
Billings 3 sphere	n/a		14:28
with Light	UPI-826		
Argos or Iridium Beacon	CP2-04 9	Beacon ID = 300234061661230	~~14:29~~
4 x 17" glass	n/a		14:29
SBE37 SMP	6823		14:29
SBE37 SMP	3266		14:33
SBE37 SMP	6832		14:36
SBE37 SMP	6327		14:39
S4	35612571		14:42
SBE37 SMP	4179		14:43
34" Syntactic buoy			14:44
Acoustic Release #1	2227	Record codes below	14:45
Acoustic Release #2	2230	Record codes below	"
500kg Anchor	n/a		14:52

Release #1 arm code _____

Release #1 release code _____

Release #2 arm code _____

Release #2 release code _____

Argos beacon #1 ID _____

Argos beacon #2 ID _____

Anchor Drop Position

Latitude 25° 8.45' N **Longitude** 52° 1.31' W

Uncorrected water depth _____ (at anchor launch)

Corrected water depth ~~4304~~ (at anchor launch)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **WB6** Cruise **JC145**

NB: all times recorded in GMT

Date 6/4/2017 **Site arrival time** 1343

Setup distance 540 m

Start time 18 13 **End time** 1544

Start Position

Latitude 26.4991°N **Longitude** 70.5225°W

5000m RATED 5x ~~Mefloat~~ rugby balls

ITEM	SER NO	COMMENT	TIME
Recovery Line	n/a		15:13
~~31" syntactic~~			"
With Light	Z02-021		—
And ~~Argos~~/Iridium	C02-052	300234061662220	—
SBE MicroCAT	6332		15:~~23~~15
SBE MicroCAT	5245		15:23
SBE MicroCAT	5238		15:27
SBE MicroCAT	3907		15:31
Nortek	6088		15:33
SBE MicroCAT	6113		15:34
31" SYNTACTIC			15:35
34" SYNTACTIC			15:37
BPR #1	Q060		1544
BPR #2	0081		"
Acoustic Release #1 (tripod)	917	Record codes below	"
Acoustic Release #2 (tripod)	2077	Record codes below	"
600kg Anchor	n/a		154420

Release #1 arm code
Release #1 release code
Release #2 arm code
Release #2 release code
[redacted]

IR ID. **~~Argos~~ beacon #1 ID**

~~**Argos beacon #2 ID**~~ —

Anchor Drop Position

Latitude 26.4946°N **Longitude** 70.5234°W

Uncorrected water depth 5434.2 (at anchor launch)

Corrected water depth 5493 (at anchor launch)

15 48 40	634	647
15 50 10	828	840
15 51 40	1017	1030
15 53 10	1204	1218

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **WB4** Cruise **JC145**

NB: all times recorded in GMT

Date 3/4/2017 **Site arrival time** overnight

Setup distance 4 miles

Start time 13:30 **End time** 17:43:18

Start Position

Latitude 26° 27.36'N **Longitude** 75° 47.69'W

ITEM	SER NO	COMMENT	TIME
Recovery Line	n/a		13:30
3 TRYMSYN floats	n/a		13:31
MicroCAT	3233		"
MicroCAT-ODO	10542		"
40" syntactic + ADCP	10584	300 234 061 660 210	13:36
iridium with ~~Argos~~ beacon	202-024		"
and light	W03-093		"
Nortek	6805		"
MicroCAT	6839		13:39
49" syntactic	n/a		13:46
iridium with ~~Argos~~ beacon	C02-039	300 234 061 660 230	"
and light	A08-079		"
MicroCAT	3901		13:48
Nortek	8502		13:56
MicroCAT	38247		"
MicroCAT-ODO	10543		"
MicroCAT	6838		14:02
Nortek	9210		14:10
MicroCAT	6802		14:12
MicroCAT-ODO	10544		"
MicroCAT	6841		14:18
12 x Orange CF-16s	n/a	11 orange, 1 yellow.	14:30
Nortek	9409		"
MicroCAT	7681		14:32
Nortek	9433		14:42
MicroCAT-ODO	10555		"
5 x yellow CF-16s	n/a		14:47
MicroCAT	4475		14:49
5 x yellow CF-16s	n/a		15:01
Nortek	9439		"
MicroCAT	3255		15:04
MicroCAT-ODO	14117		"
5 x yellow CF-16s	n/a		15:19
MicroCAT	3900		15:21

5 x yellow CF-16s	n/a		15:36
Nortek	9444		"
MicroCAT	6799		15:37
5 x yellow CF-16s	n/a		1553
MicroCAT	3484		1154
MicroCAT-ODO	10556		1156
5 x yellow CF-16s	n/a		16:12
Nortek	13482		"
MicroCAT	5979		16:14
MicroCAT	5776		16:29
Nortek	13588		16:34
10 x glass	n/a		16:40
Acoustic Release 1	2221		16:43
Acoustic Release 2	918		"
2700kg Anchor	n/a		17:43:18

Release #1 arm code
Release #1 release code
Release #2 arm code
Release #2 release code
Argos beacon #1 ID 202-04
Argos beacon #2 ID ~~Argos~~ IRIDIUM 002-039

Anchor Drop Position
Latitude 26° 26.98° N **Longitude** 75° 43.22' W

Uncorrected water depth 4648.2 M (at anchor launch)
Corrected water depth 4683.6 M (at anchor launch)

Triangulation Sheet

Location (e.g. 1, 2 3)	Release SN or	Time	Latitude	Longitude	Range 1 (m)	Range 2 (m)
1		180505			—	—
		180550			—	4738
		0635			4801	4820
		181200			5329	5329
		181300			"	5329
2		183800			5469	5469
		" " 30			5469	5469
3		190740			5364	5364
		190820			5365	—

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **WB4L** Cruise **JC145**

NB: all times recorded in GMT

Date 2/4/2017 **Site arrival time** —

Setup distance 0

Start time 1912 **End time** 1912

Start Position

Latitude _____ **Longitude** _____

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		1912 11
DeepWater Buoyancy Lander			"
With Light		confirmed working ~230	"
~~Argos~~ or Iridium Beacon	J03-JDW	Beacon ID = 300234061666 msgs recieved	"
SBE26/53			"
SBE26/53			"
Acoustic Release #1	2074	Record codes below	"
Acoustic Release #2	1535	Record codes below	"

Release #1 arm code [redacted]

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID

Anchor Drop Position

Latitude _____ **Longitude** _____

Uncorrected water depth _____ (at anchor launch)

Corrected water depth _____ (at anchor launch)

SN	time	range 1	range 2	
2074	191420	—	118.6	
"	191500	136	140	} 42 m/min
"	" " 30	157	161	
	191600	178	183	
	~~xxxxxx~~			
	191900	312	—	≈ 44
	194800	1524	1529	
	194630	1547	1551	≈ 46 m/min

3 (134) 44

AT Δ POSITION 1. SO NOT DIRECTLY ABOVE IT. → ~1.5 MILES AWAY

SN 1535		
20:45:00	—	4845
20:45:40	4858	4863
20:46:00	4869	4874
20:46:40	4891	4895
20:56:30	5257	5263
20:57:00	5271	5280

} 33 m/min

~~21:06:10~~		/	/
①	21:06:30	5281	5281
	21:07:00	1746x	2104x.
N 2074	21:07:40	5282	5281
"	213540	5464	5464
535	213700	5469	5469

3RD POSITION

③	22:00:55	5506	1751x	FAIR BIT OF TRANSFER NOISE.
	22:01:25	5511	4983x	
	22:02:00	11106x	5513	
	22:02:35	5514	3334x	

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **WBH2** Cruise **JC145**

NB: all times recorded in GMT

Date 1/4/2017. **Site arrival time** overnight.

Setup distance 2.5 miles

Start time 13 30 **End time** 16 13

Start Position

Latitude ~~[illegible]~~ 26.5126 °N **Longitude** ~~[illegible]~~ 76.6052 °W.

ITEM	SER NO	COMMENT	TIME
Recovery Line	n/a		13:30
Billings float	n/a	IRIDIUM BEACON: IMEI 300234031663230 Light W03-092	13:31
12x 17" glass	n/a		13:34
RAS-500	13278-04		13:40
Nortek	6751		"
MicroCAT-ODO	14147		13:42
MicroCAT-ODO	12900		13:55
7 x 17" glass	n/a		14:04
Nortek	6753		"
MicroCAT	6118		14:06
5 x 17" glass	n/a		14:28
Nortek	9266		"
MicroCAT	6811		14:30
MicroCAT-ODO	14149		14:43
5 x 17" glass	n/a		14:53
Swivel	n/a		"
Nortek	9402		"
MicroCAT	~~5984~~		14:55
MicroCAT	6122		15:08
5 x 17" glass	n/a		15:18
Nortek	9406		"
MicroCAT	4468		15:22
6x 17" glass	n/a		15:25
Acoustic Release #1	2222		15:29
Acoustic Release #2	2225		"
1850kg Anchor	n/a		16:13:33

Both releases talking

Release #1 arm code [redacted]

Release #1 release code

Release #2 arm code

Release #2 release code

Argos beacon #1 ID 300234031663230

~~**Argos beacon #2 ID**~~

Anchor Drop Position 26.4812° ~~[illegible]~~ 76.6264° W ~~[illegible]~~

Uncorr. water depth 4692

Corr " 4729

Latitude _____ Longitude _____

Uncorrected water depth _____ (at anchor launch)
Corrected water depth _____ (at anchor launch)

Triangulation Sheet

Area:
#1,
#2,

Location (e.g. 1, 2 3)	Release SN or ARM	Time	Latitude	Longitude	Range 1 (m)	Range 2 (m)
1		164320			—	5300
		164400			5344	5361
		164540			5416	5415
		" 4620			5417	5418
		" 4710			—	5417
2		171540			5288	5289
		171640			5291	5292
3		174510			5507	5504
		" " 40			5503	5503

} still going down

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **WB2** Cruise **JC145**

NB: all times recorded in GMT

Date 30/3/17 **Site arrival time** _____

Setup distance 4 nm

Start time 13:37 **End time** 17:00:20

Start Position

Latitude 26° 56.86' N **Longitude** 76° 68.96 W

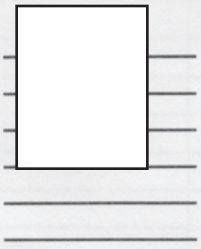
ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		13:37
3 x Mini-Trimsyn	n/a		13:38
SBE37 SMP	4795		13:39
30" syntactic float	C02-038		13:46
with Light	~~Z02-018~~		"
~~Argos or~~ Iridium Beacon		Beacon ID = 300234061669 220	"
Nortek	6516		"
SBE37 SMP	3221		13:47
51" syntactic float	304?		13:54
with Light	Z02-020		"
~~Argos or~~ Iridium Beacon	304?	Beacon ID = 82895	"
Nortek	5899		"
SBE37 SMP	6834		13 56
SBE37 SMP	4721		14:02
2 x 17" glass	n/a		14:06
Nortek	5967		"
SBE37 SMP	6829		14:10
SBE37 SMP	4714		14:17
2 x 17" glass	n/a		14:22
Nortek	6049		"
SBE37 SMP	~~4714~~ 3253		14:26
SBE37 SMP	5783		14:32
10 x 17" glass	n/a		14:41
Nortek	~~6119~~ 6083		"
SBE37 SMP	3234		14:44
Nortek	~~6132~~ 6119		14:54
SBE37 SMP	3222		14:55
5 x 17" glass	n/a		15:03
SBE37 SMP	5777		"
SBE37 SMP	3206		15:09
Nortek	6132		15:15
5 x 17" glass	n/a		15:27
SBE37 SMP	5766		"
SBE37 SMP	~~3256~~	3256	15:40
2 x 17" glass	n/a		15:47

~~6132~~

etd 16:50

Nortek	6176		15:47
5 x 17" glass	n/a		1500
SBE37 SMP	3229		"
SBE37 SMP	3224		16 15
10 x 17"glass	n/a		1618
Acoustic Release #1	361		
Acoustic Release #2	1357	Record codes below	
2500kg Anchor	n/a	Record codes below	17:00 20

Release #1 arm code
Release #1 release code
Release #2 arm code
Release #2 release code
Argos beacon #1 ID
Argos beacon #2 ID



Anchor Drop Position
Latitude 26° 51.18' N **Longitude** 76° 74.29'W

Uncorrected water depth 3875.90 (at anchor launch)
Corrected water depth 3895.40 (at anchor launch)

10

mlistst ('cruv', start time, end time,
'time lat long')

('sim', 1,
'time depthm')

('em120'

mcatter (lat, long, uncor depth)

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **WB1** Cruise **JC145**

NB: all times recorded in GMT

Date 30/03/17 **Site arrival time** _____

Setup distance _____

Start time 18:48 **End time** _____

Start Position

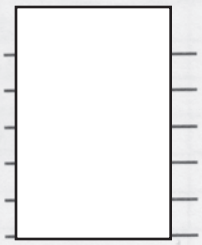
Latitude _____ **Longitude** _____

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		18:48
Mini-Trimsyn	n/a		18:50
30" syntactic float	n/a		"
with Light	B11-018		"
Iridium and ~~Argos~~ Beacon	C02-043	Beacon ID = 300234-06166 7220	"
6 x 17" glass	n/a		"
RAS-500 with	13278		18:55
Contros	C21114-002		"
SeaFET	721-0105		"
MC-MICROCAT-ODO	14151		"
RBR-SoloT	100281		"
SBE37 MicroCAT	6853		"
6 x 17" glass			19:03
Nortek	5590		"
SBE37 MICROCAT	3916		"
RBR-SoloT	100274		19:06
RBR-SoloT	100257		19:08
45" syntactic float	n/a		19:13
with Light	A08-080		"
and Argos Beacon	A08-075	Beacon ID = 121994	"
RBR-SoloT	100268		"
RBR-SoloT	100267		19:15
RBR-SoloT	100269		19:17
Nortek	5885		19:23
SBE37 MICROCAT	6831		"
MC-MICROCAT-ODO	14145		"
RBR-SoloT	100253		19:25
RBR-SoloT	100270		19:27
RBR-SoloT	100260		19:29
RBR-SoloT	100273		19:30
RBR-SoloT	100259		19:32
ADCP+44" Sphere up looking	5476		19:39
75kHz ADCP down looking	10583		19:43
Swivel-Ti	n/a		"
RBR-SoloT	100271		"

RBR-SoloT	100266		19:44
Nortek			19:~~45~~52
SBE37 MICROCAT		100-	"
MC-MICROCAT-ODO		RBRs: 262, 264, 265, 272, 275, 276	"
2 x 17" glass	n/a	277, 278	20:09
Nortek	12722		"
SBE37 MICROCAT	5772		"
Swivel-Ti	n/a		"
~~7~~ x 17" glass	n/a		20:19
Acoustic Release #1	1202	Record codes below	20:22
Acoustic Release #2	251	Record codes below	"
2400kg Anchor	n/a		210530

8 x RBRs

Release #1 arm code
Release #1 release code
Release #2 arm code
Release #2 release code
Argos beacon #1 ID
Argos beacon #2 ID



Anchor Drop Position
Latitude _____ **Longitude** _____

Uncorrected water depth _____ (at anchor launch)
Corrected water depth _____ (at anchor launch)

ITEM	SERIAL NUM	TIME
RBR	100262	19:52
RBR	100264	19:53
"	100265	19:55
"	100272	19:57
"	100275	19:59
"	100276	20:00
"	100277	20:02
"	100278	20:04
"	100255	20:10
"	100256	20:12
"	100271	20:19

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **WBADCP** Cruise **JC145**

NB: all times recorded in GMT

Date 28/3/17 **Site arrival time** 17:42

Setup distance N/A

Start time 17:42 **End time** 17:48

Start Position

Latitude N/A **Longitude**

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a		17:42
40" syntactic float	n/a		17:44
with Light	W03-096		"
Argos ~~Iridium~~ Beacon	AD8-074	Beacon ID = 121995	"
ADCP	23643		"
Acoustic Release #1	2220	Record codes below [redacted]	17:46
Acoustic Release #2	2224	Record codes below	"
800kg Anchor	n/a		17:48:15

Release #1 arm code [redacted]
Release #1 release code
Release #2 arm code
Release #2 release code
Argos beacon #1 ID 121995
~~Argos beacon #2 ID~~ —

Anchor Drop Position
Latitude 26° 31.82' N **Longitude** 76° 52.00' W

Uncorrected water depth ECHOSOUNDER OFF (at anchor launch)
Corrected water depth (at anchor launch)

300 m from swath.

2

Triangulation

#1, [redacted]
183220, —, 1588
183250, 1588, 1588
183350, —, 1588

#2,
192850, —, —
" 2950, 1035, 1035
3025, 1036, 1036

#3,
010620 2370, 2399
" " 50 2227, 7747
010740, 1996, 6337
010820, 1807, —

RAPID-WATCH MOORING LOGSHEET **DEPLOYMENT**

Mooring **WBAL67** Cruise **JC145**

NB: all times recorded in GMT

Date 28/3/17 **Site arrival time** 2132

Setup distance —

Start time 2132 **End time** 2136

Start Position

Latitude 26·5375°N **Longitude** 76·8666°W

ITEM	SER NO	COMMENT	TIME
Recovery line	n/a	~~OK~~	2132
Billing-12"	n/a		2133
Billings 3 sphere	n/a		"
with Light	U01 027		"
Argos or ~~Iridium~~ Beacon	B03-078	Beacon ID = 129571 on on	"
4 x 17" glass	n/a		2134
4 x 17" glass	n/a		"
4 x 17" glass	n/a		2135
SBE26/53	0428		2136
SBE26/53	0054		"
Acoustic Release #1 (tripod)	822	Record codes below	"
Acoustic Release #2 (tripod)	911	Record codes below	"
1200kg Anchor	n/a		213650

Release #1 arm code —

Release #1 release code —

Release #2 arm code —

Release #2 release code —

Argos beacon #1 ID 129571

~~**Argos beacon #2 ID**~~ —

Anchor Drop Position

Latitude 76·8662°W (76°53·17') **Longitude** 26·5373°N (26°32·238')

Uncorrected water depth — (at anchor launch)

Corrected water depth 612 (at anchor launch)